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After 15 minutes. Flat.

GOODRICH
After 15 minutes. Flat.

MICHELIN
After 15 minutes. Flat.

UNIROYAL
No air loss.

Competitive drilling test
with 3/16" drill bit
puncturing Royal Seal.

Testing was supervised by an independent testing laboratory.

UNIROYAL FLATTENS THE COMPETITION.

Why would we drill a hole in 4 leading brand-name tires? For one very good reason: to prove that all steel-belted radials are not alike. To prove that Uniroyal's Royal Seal is the one that won't leave you flat.

We drilled a 3/16-inch hole in each tire. The results: Goodyear, Goodrich, and Michelin were flattened. Uniroyal wasn't. That's because inside the Royal Seal is a rubber sealant compound that effectively seals 90% of tire-tread punctures of 3/16" or less in diameter, the size of most tread punctures. Without jeopardizing the tread, the balance or the uniformity of the tire. So you can drive for the full life of the tire.



When the tread is punctured, Uniroyal's special sealant automatically surrounds the puncturing object. As the object is withdrawn, the sealant fills the gap, preventing the air's escape.

This is great news if you don't like stopping on busy highways or lonely back roads. With Royal Seal, chances are you won't get one of the approximately 53 million flat tires that happen in America yearly.

When you're looking for the right tire remember the test that proved Uniroyal best. When you compare us for quality and compare us for price...you'll buy the tire that won't leave you flat. Royal Seal.

WHEN YOU COMPARE, YOU WANT.

This One



37US-G89-0813

For a free brochure on the Royal Seal tire, please send your name and address to: Advertising Dept., Uniroyal, Inc., 1230 Ave. of Americas, New York, N.Y. 10020.

The Royal Seal is available at Cadillac, Chevrolet, Buick, Pontiac, Oldsmobile, Ford and Lincoln-Mercury and Uniroyal dealers.



One of these helmets came off the field and off the market when the rules of the game changed.

Not the football rules, but the rules of the legal system under which manufacturers can be sued for damages. In recent years, courts have been inclined to hold a product manufacturer or distributor liable for injuries even when the company had met safety standards or when the injured person was negligent in using the product.

As a result, judgments, settlements and legal costs in liability cases have increased dramatically. Businesses are faced with uncertainty in trying to gauge the extent of their exposure to lawsuit. When these factors outweigh the benefits of making a product, that product will leave the marketplace.

That's what happened to the manufacturer of the helmet on the right. He stopped production of helmets until, as he says, the legal climate changes in the United States. It has happened also to some makers of vaccines, plastic products and machines. Right now, the chemical and pharmaceutical industries are deeply concerned about the potential financial impact of recent court decisions.

As a major group of property and casualty insurance companies, we, too, are concerned about this problem. Our companies provide insurance designed to protect business from financial loss resulting from a lawsuit. This protection normally encourages business to remain in the marketplace. It enables manufacturers to develop new products, to provide more jobs and generally to contribute to our economy.

But the trend in legal judgments threatens all that stability. As lawsuit settlements and awards become higher, insurance companies tend to be more cautious in writing insurance coverage. And they must charge more for it. That in turn causes manufacturers and sellers to raise their prices to cover the increased cost of insurance protection. Which means that consumers pay more for what they buy.

It's frustrating, but not hopeless. Steps can be taken to prevent injuries and to control the rise of liability costs. And that would benefit everyone.

Here's what we're doing:

- Helping to develop standards for safer products.
- Advising manufacturers on safety procedures and loss prevention programs.
- Supporting legislation to reduce the enormous legal costs of administering the product liability system.
- Supporting legislation to make the standards of legal liability more definite, more predictable and more equitable.

Here's what you can do:

- Seek quality products. Check to see that they meet safety standards where appropriate.
- Use all products as they are meant to be used. Read and follow warning labels and instructions for product usage.
- Get involved! Become aware of proposals to improve fairness in the legal liability system.

Affordable insurance is our business...and yours.

This message is presented by the **American Insurance Association**, 85 John Street, New York, New York 10038.



On the cover

PM's own workbench and portable toolbox, designed for ruggedness and with many practical features, lead this issue's 20 pages of woodworking projects you'll find easy to build and rewarding. Workbench plans begin on page 112.
—PM photo by Jerry Abramowitz

Popular Mechanics

NOVEMBER 1980

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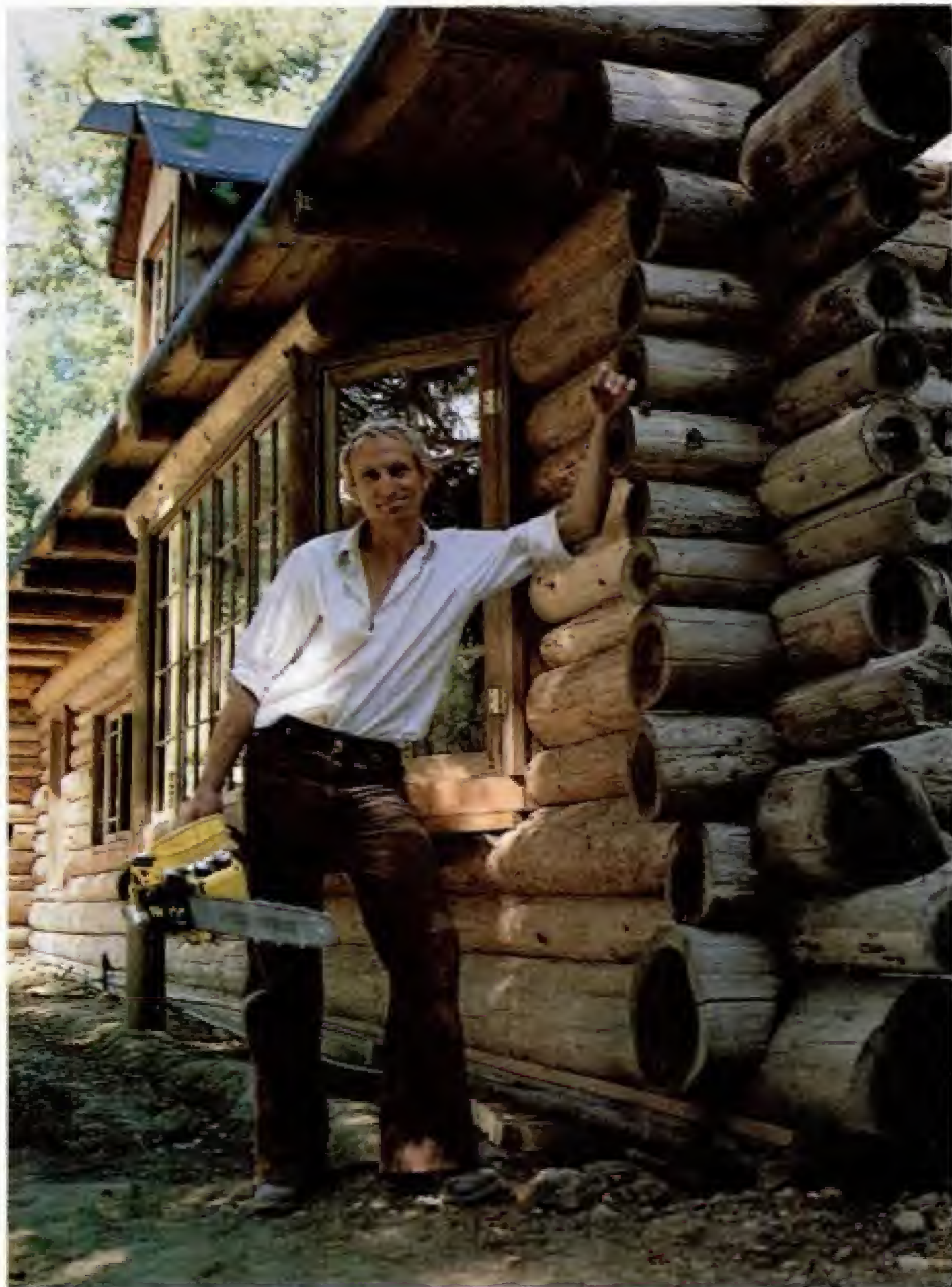
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Lincoln would have loved it.

When my wife and I came out here to build our own log cabin, we left everything behind.

Except for a few clothes, some camping gear, an old axe, and my John Deere Chain Saw.

Well, the clothes have come in handy, and so has the tent. But I would have been lost without the chain saw.

In the beginning, I tried using an axe, just like Lincoln. But in the time it took me to cut a good size tree, I could cut enough logs for a whole wall with the chain saw. It seemed to glide right through even the toughest wood.

As you can see, the house is almost finished. With all the work that went into it, I've really come to appreciate the kind of man that Lincoln must have been.

But I appreciate this John Deere Chain Saw a lot more.



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“I can show you how to give a gift that’s a labor of love. Without too much labor.”

—Homer Formby 3rd generation restorer and refinisher

Think hard for a minute. Try to remember some of the gifts you gave last Christmas. Can you even remember the gifts you got? Don’t feel bad — most people can’t.

And I’m sure a lot of money was spent on those presents. Even so, they just weren’t that special or memorable.

I’d like to give you and your family a suggestion based on something we do in our family. Find an old picture frame. Or an old mirror. Or a small table. It doesn’t matter where you find it — though it sure would be nice if you can poke around the attic or the basement and find something that belonged to your grandfather or grandmother.

Next, refinish that piece and put it under the tree. Now before you tell me refinishing is a sloppy, time-consuming business, let me stop you. Have you heard about my furniture refinisher?

Formby’s Furniture Refinisher ends the drudgery of refinishing. You’ll find that refinishing doesn’t have to be a big deal, or an ordeal. Just apply some of my Refinisher with my refinishing pads and watch the old varnish, lacquer or shellac finish dissolve away right before your eyes. You know what? It’s so easy it really can be an all-family project. Even the kids can do it.

There’s no sanding. No stripping. No staining. Why

there’s not even any hard rubbing. (You can put away your supply of elbow grease.) And my refinisher protects the patina of your wood. Patina is the richness and character that’s built up over time. So whatever you refinish, it’ll look like a beautiful old piece — not a piece that could have been bought yesterday. And forgotten tomorrow. Watch it stand out from the plastic and tinsel. It’ll be a gift that won’t be soon forgotten, believe me.

How long will it take? You can refinish a picture frame in less than one hour! And that includes hand-rubbing in a beautiful tung oil finish. A small table takes just two hours, from start to refinish.

So this Christmas, don’t give another sweater or another pair of furry slippers. Put something under the tree you’ve put yourself into. Remember, it’s a gift from your heart because it’s a gift from your hands.

To get you started many of our dealers have a special price on Formby’s Furniture Refinisher. Think of it as our Christmas gift to you.

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LETTERS TO THE EDITOR

We knew it could be done

In regard to your article *A Home Designed to be Heated by One Stove* (page 86, Aug. '80), lots of people have been heating their homes this way for years in the mountainous area of northern Pennsylvania.

I have a colonial-style home without any insulation and can heat it completely on wood alone, providing the temperature outside doesn't drop below 15° F. The stove is located in the basement, with ducts running throughout the house.

RICH STAINO
DREXEL HILL, PA.

Right on. For more helpful tips on getting the most from a wood stove and other space heaters, see the story on page 104 in this issue.

Tornadoes: A stormy protest

I was astonished to read in your article *How Tornado Labs Tame Giant Twisters* (page 64, Aug. '80) that "New research suggests how to avoid injury during a tornado: Seek shelter on the lowest level of a building."

I grew up in tornado country—Texas and Oklahoma—50 years ago and was taught early in childhood to get out of the house and seek shelter in the lowest spot in the vicinity—like a ditch beside the road. I remember one summer in Austin when a neighbor came screaming that a tornado was headed toward us. We all crouched in a deep ditch and were pelted by hailstones. The tornado took out every house in a two-block area.

So, you see, the information is *not* new. It has been known by generations of people who did not have to be told by so-called "scientists."

HELEN W. KENYON
SEBASTOPOL, CALIF.

You're right that getting as low as possible is a matter of common sense, and has probably been practiced since the days of cavemen. What modern tornado research does indicate, however, is that it is safer to stay in a building than leave it—and this is contrary to what most of us were taught as children.

Family-style Mini-Indy

Here is a picture (upper right) of two proud owners of your Mini-Indy racer (*Build PM's Mini-Indy II*, page 110, May '78). One reason they're so



Two proud young owners of PM's Mini-Indy II racer—and dad can even drive it, too.

proud is that they both did quite a bit of the work on it.

We made a couple of changes—a tilting steering wheel and adjustable foot pedals—so an adult can get in and drive it, too. It's a fine design and good family project.

JAMES P. CANNAHAN
CHRISTOPHER, ILL.

For others who may be interested, complete plans for PM's popular Mini-Indy II are \$5 postpaid from Stevenson Publications, Box 584, Del Mar, Calif. 92014.

Sometime solar dollars

I enjoyed your rundown last year of available grants and tax advantages for installing solar heating (*How to Get Dollars to Go Solar*, page 90, Nov. '79). However, after putting in 100 square feet of south-facing glass with appropriate overhangs, I was dismayed to read the fine print in IRS publication No. 903, *Energy Credits for Individuals*. It says, "... components that serve a significant structural function, such as extra-thick walls, windows, skylights, greenhouses and roof overhangs, are not included as solar-energy property."

The IRS has turned off the incentive tap for thousands of tinkerers, one that could make a national energy difference through the proper use of such improvements. As it is written now, the energy-credit program might as well not even address passive solar-heating systems.

JOE HALLY
DILLON, MONT.

It's true that window walls do not, by themselves, qualify for tax credits under current IRS provisions. They may qualify, however, when installed in combination with a solar collector or energy-storage system. Also, the IRS does make allowances for many

passive improvements, such as insulation, weatherstripping and thermal windows. Readers contemplating energy-related improvements should consult their local IRS office to find out just what will, and will not, earn tax benefits. They may be in for a pleasant surprise.

Thanks for the Memorex

In the July issue, the article *Coming: Big-Screen TV by Laser* (page 24) erroneously states that no video cassettes are made in the United States. Memorex Corp. manufactures a complete line of advance-quality VHS video tape. The tape and plastic cassettes are manufactured in the United States.

JOHN R. HUMPHREYS
MEMOREX CORP.
SANTA CLARA, CALIF.

Hood-winked

In reference to the new computer game "Computer Bismarck" (*PM Electronics Monitor*, page 13, Aug. '80), you mention that the British warship *Hood*, sunk by the German *Bismarck* in WWII, was a battleship. Actually, H.M.S. *Hood* was one of the last of the faster but more lightly armored battle cruisers, and really had no right being on the same piece of ocean with the heavily armed and armored *Bismarck*.

ROSS A. SHORT
PARIS, ONT.

Loves those custom car seats

Sure enjoyed your article on the customized Pontiac (*Turn Your Stock Car into a Show Car*, page 94, Sept. '80). Would dearly like to know where I can purchase the Scheel custom seats.

FORD SHRODER
DORSET, VT.

The Scheel seats are available from Scheel Auto Seats, 17101 South Central Ave., Carson, Calif. 90746.

Price update

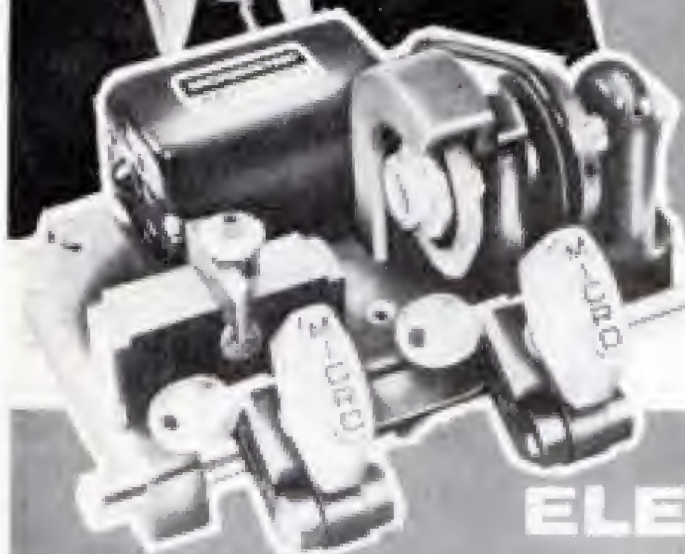
The price of the Woodox four-way wood-splitting wedge, reported on in May (*PM Looks at Super Log Splitter*, page 24), has been raised slightly. The price originally quoted (\$34.45) is still correct, but no longer includes shipping charges, which vary from area to area. Purchasers may pay the charges C.O.D. or write for them to Woodox, 105 North Hanover St., Pottstown, Pa. 19464. **PM**



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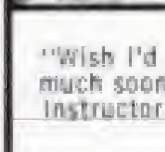
lence. Everyone wants a locksmith...for homes, apartment buildings, cars, bikes, hospitals, vending machines, banks, businesses...wherever security is essential. As a Master Locksmith, with the professional know-how to do major installations as well as simple jobs, you will find your time well paid for...and interesting, too.

LOCKSMITHING INSTITUTE does not guarantee how much you'll make or be hired to do...but we do guarantee that our graduates are Master Locksmiths, qualified professionals. It's been that way since 1948. And that's a guarantee all by itself, isn't it?

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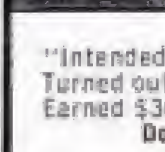
"After completing a few lessons, I started doing small jobs...earned \$500 spare time. Now earning \$100 extra per week."
E. E. Neel, Houston, Tex.



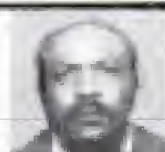
"Wish I'd taken the Locksmithing course much sooner. Earned \$380 while training! Instructor was very helpful and prompt."
John F. Lewis, Chicago, Ill.



"My main motivation was independence. Earned \$500 part-time while still studying. Definitely see more potential earnings."
Gerald Sosentovich, Pte. Claire, Que.



"Intended to make locksmithing a hobby. Turned out to be a source of extra income. Earned \$300 part-time while training."
Donald J. Brooks, El Monte, Calif.



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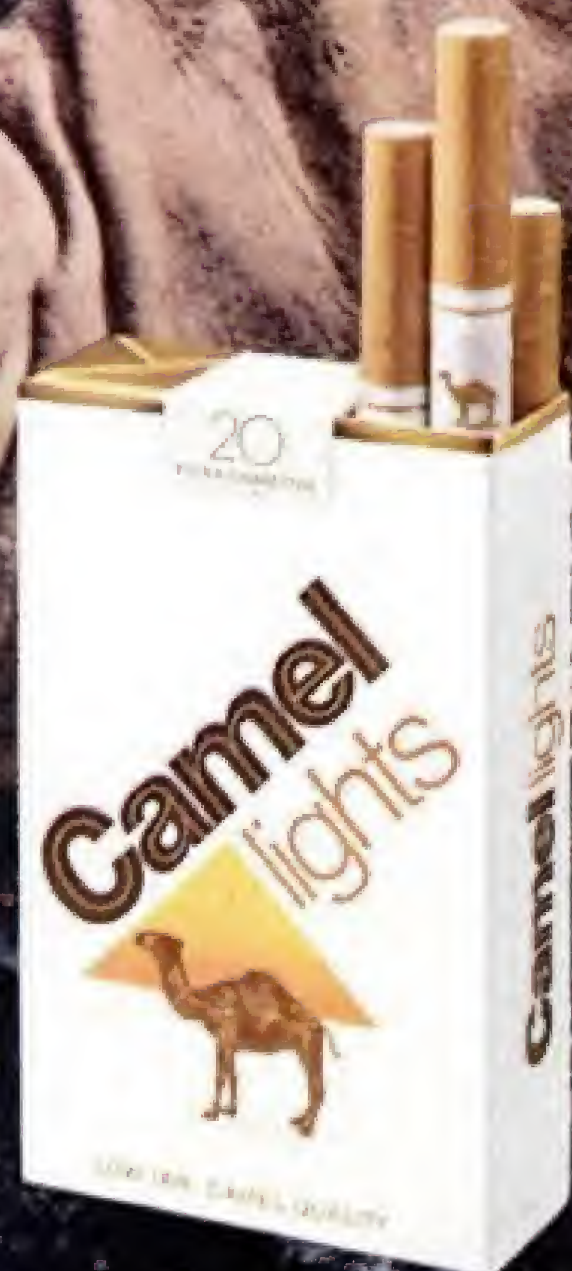
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PM ELECTRONICS MONITOR

Get down

Today's disco beat often requires an extended bass response in order to vibrate the eardrums and rattle the bones. However, getting extra-deep bass without distortion can be difficult.

One way out is to employ what is called a *subwoofer*. In most speakers there is a small *tweeter* speaker that responds to highs, and a larger *woofer* for lows. A subwoofer is simply a speaker that responds only to the very lowest frequencies, and thus enhances those frequencies.

But output from your amplifier must go through a *crossover* before hitting the actual speakers. This crossover channels highs to the tweeter and lows to the woofer.

Most crossovers that offer the subwoofer option are expensive. However, we saw the specs on an interesting crossover from Ace Audio Co. (532 5th St., East Northport, N.Y. 11731).

The DSB-6500 allows a subwoofer connection, and distortion is said to be just .002 percent. It's \$142 wired and \$103 in kit form.

Control your phone

The Phone Controller from Dictograph was announced too late to be included in the Sept. '80 story on electronic telephone accessories (*Today's Telephones: Too Smart to Just Ring!*, page 90). This new device has a number of unique and interesting features.

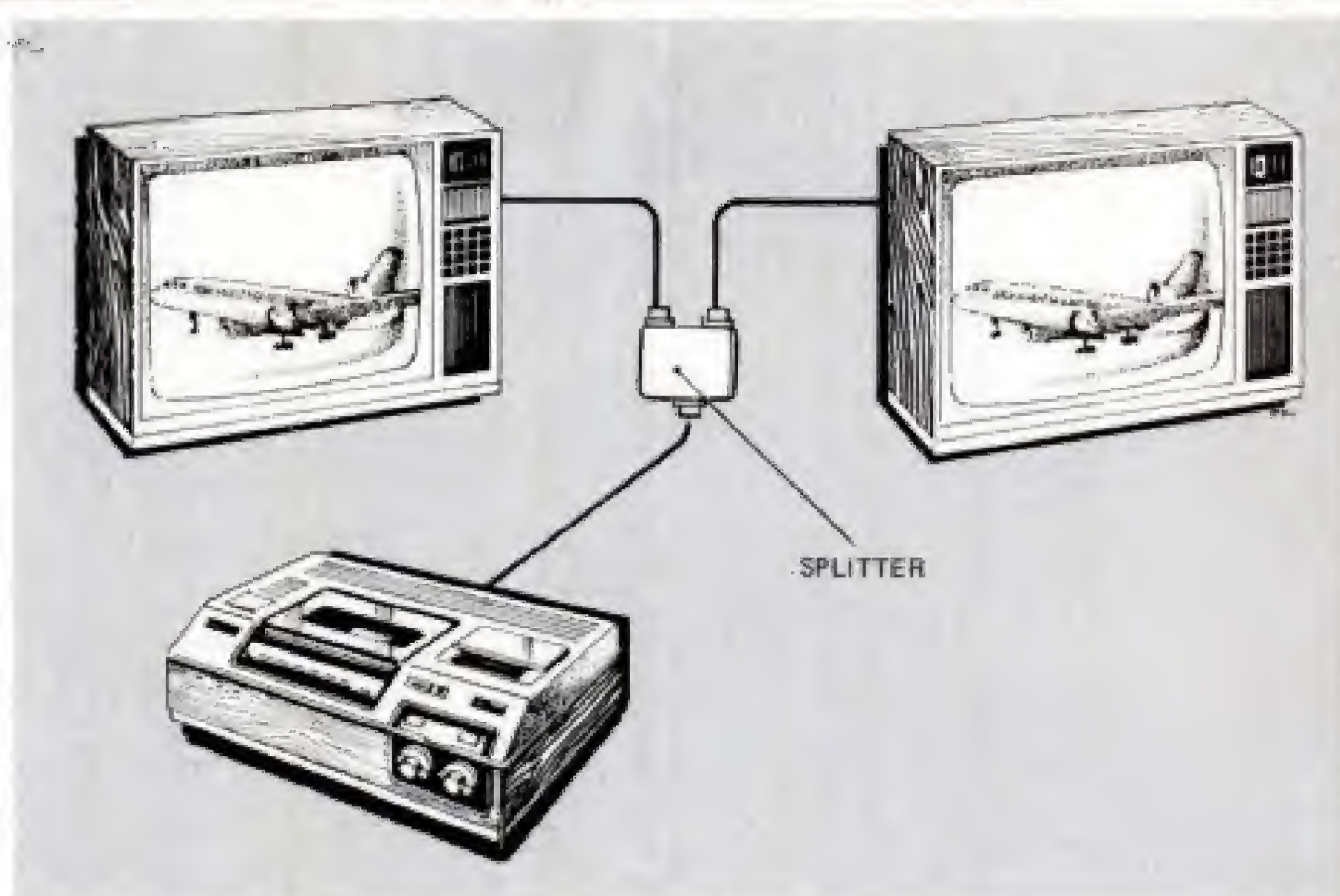
About the size of a large memo pad, it will store and recall up to 30 phone numbers and display them on its LED digits. It also features an electronic "lock" which can both prevent unauthorized use and keep memorized numbers a secret. The Phone Controller will retail at \$99.95.

Videodisc musings

Before writing a story on one of the new videodisc machines, I used the unit in my home for a few weeks. As always, using a device uncovered a number of pros and cons not mentioned in the literature.

First of all, it was amazing how quickly my family adjusted to the machine's presence. In less than an hour, it seemed a natural adjunct of the television—so much so, that we began to miss slow-motion and reverse when watching normal TV broadcasts.

But there was one minor drawback to the disc, one that I have not



Handy hardware for splitting up the signal

If you are lucky enough to have a videotape recorder (VTR), you probably would like to use it with every television in the house. Wiring and routing the thick coaxial cable can prove to be more than just a challenge—if connections are made improperly, the picture quality will suffer.

There is one quick way to feed a VTR's output to two or more TVs with a minimum of wiring. You simply use a *splitter*, such as is used to send the signals of one antenna to two TVs. In this method, connect the system as shown in the diagram above.

seen mentioned anywhere else. The problem is that the videodisc machines are comparable to manual turntables, rather than to automatic record changers.

During a typical movie, covering five disc sides, I had to get up to flip and/or change a videodisc four times. As a neighbor remarked to me, "This is almost as bad as commercials!"

The effort required is minimal. But any interruption breaks your concentration on the movie and spoils the theater-like experience.

As far as I can see, the technology involved in the laser machines could be adapted to automatic changing only with difficulty. The laser "needle" reads the disc from underneath. A protective cover locks above the disc, which is spinning at hundreds of rpm. There is literally no way to drop the second video platter.

The capacitance systems that are not yet out will (in at least one variation) have a grooved disc. But there, too, the problem of such a quickly spinning disc would seem to rule out automatic changers.

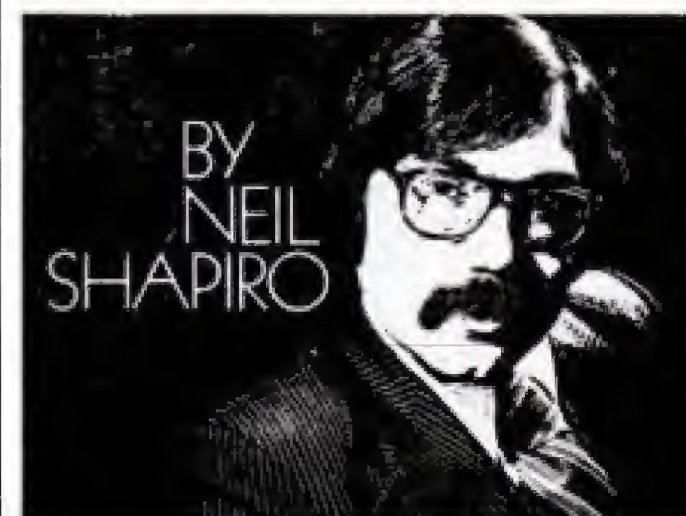
Tape, of course, allows a movie to be played without any interruption. But taped movies are much more expensive than the disc versions. We watched one well-known feature on a set of discs that sold for \$24.95—a

comparable tape would have cost \$100 or more.

So, savings realized by building a movie library of videodiscs, as opposed to the same library on prerecorded videotape, could easily make up for this one drawback to the videodisc. After all, if you can afford to own 50 movies, instead of only a dozen, then taking the trouble to flip the discs begins to look better and better.

Still, I think this points out at least one area that future videodiscs will be designed to reach. In about two or three years, there just might be automatic videodisc changers.

Besides savings, the videodisc systems also offer a multitude of other fun features. The ability to single-step a movie, frame by frame, and then stop the motion for a long time, is a real convenience. **PM**



OUR PORTABLE GENERATOR IS AN OVERNIGHT SUCCESS.

Yep, it's easy to spot the one guy with a McCulloch portable generator.

The house with the lights burning in the middle of a blackout. And a freezer full of cold food. And a nice hot shower.

A McCulloch portable generator is a powerful, dependable machine. Built with the same tough quality as a McCulloch chain saw.

Of course, you don't have to wait for a blackout. A portable generator can be just as useful around a campsite. Or for running power tools outdoors.

But the time to think you might need a portable generator isn't while you're shivering in the dark, fumbling for a flashlight.

It's right now, at your McCulloch dealer.



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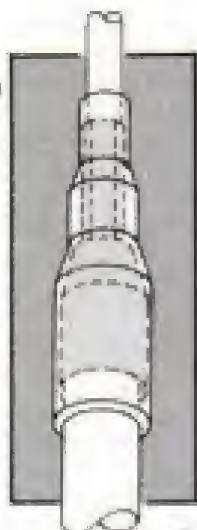
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INSUL-SLEEVE™
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NOTES FROM THE EDITOR

John A. Sallittin

Too bad we can't really use this cover on our upcoming February issue. As all Muppet aficionados will instantly realize, the PM cover girl here is Miss Piggy, who was photographed in her workshop engaged in "frog-building for fun and profit." The PM cover is one of 12 parodies of leading national magazines that appear in the Miss Piggy

In February, Miss Piggy fans can dream of tackling such challenging projects as making a motorized cheese board from a kit, as well as constructing a bird sauna and a bat feeder. But the workshop prize-winner is frog-building for fun and profit.



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Cover Girl Fantasy Calendar for 1981. Each cover also casts Kermit the Frog in a supporting role. The *National Geographic* Pacific Island August cover, for instance, depicts the porcine beauty as Queen Wahinipikki I lounging in a ceremonial barge being paddled by a dozen native frogs. Cover lines for each month offer typical fare for each of the magazines—but of a kind you've never seen before. September *Cosmopolitan* reveals "What It Means When Your Plants Move Out." Want more? The 1981 Miss Piggy calendar is \$7.95 in bookstores.

We nearly lost Home and Shop Editor Harry Wicks in the north woods of Michigan a few weeks back. No, it wasn't that he got off the trail. It was just that he found the latest in our series on Great Shops (page 108) in such an idyllic setting that he could hardly bear to return to the office. All shops in the series, including the one in this issue, are outstanding examples of home workshops. Many of us only dream about having equally beautiful setups, but all of the shops we present are loaded with ideas anyone can use in any shop. Maybe you have a layout that would qualify for our series. If so, see the instructions on page 110 for telling us about it; we'll be delighted to consider it. **PM**

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Build PM's Battery Brain to test and recharge most cells

Here's the answer to your battery blues. This tester sorts batteries into the good and the bad, and rejuvenates those that aren't too far gone.

by Jeff Sandler

Battery Brain clips are connected to the battery to be tested. If it needs charging, you plug in the battery eliminator or another 9- to 15-v. source at jack J1.

Everybody knows that batteries "give up" just when you need them most. You can prevent this frustrating annoyance with PM's Battery Brain. It has features not normally available on chargers, such as an adjustable charge rate. But particularly valuable are an automatic current cutoff that prevents a damaging overcharge and a light that lets you know your batteries are "ready."

Testing is a snap. All you do is flip a switch that corresponds to your battery voltage, touch the clips to the battery terminals, then watch the meter. If the meter needle moves, your battery has life. How much depends on how far the needle moves toward the 1.5 mark (0.9 means dead and 1.5 indicates a full charge).

If the needle doesn't move at all, throw out the battery.

How it works

Consider a single carbon-zinc or alkaline flashlight battery. Fresh from the store, it's rated at 1.5 v., but this falls steadily as the battery is used. The 1.5 and 0.9 on the Battery Brain meter scale represent the working voltage range of a single-cell, 1½-v. battery.

But say you want to test a more powerful 9-v. radio battery (composed of six 1½-v. cells in series).

The Battery Brain simply divides all the voltages by six.

Charge! (and save)

Nobody has to tell you that you are spending plenty on batteries nowadays—probably \$20 or more over a year's time.

Charging is as simple as testing with the Battery Brain. Once it is set up to test a battery, plugging a 9- to 15-v. source into the Battery Brain's jack automatically converts it into a charger.

The meter still works, except that it now measures the rising voltage of the battery as it is charged. A light shows that you're charging and goes out when your battery is fully charged. If you want to charge a battery of different voltage, just flip the switch on the case to whatever new voltage is desired.

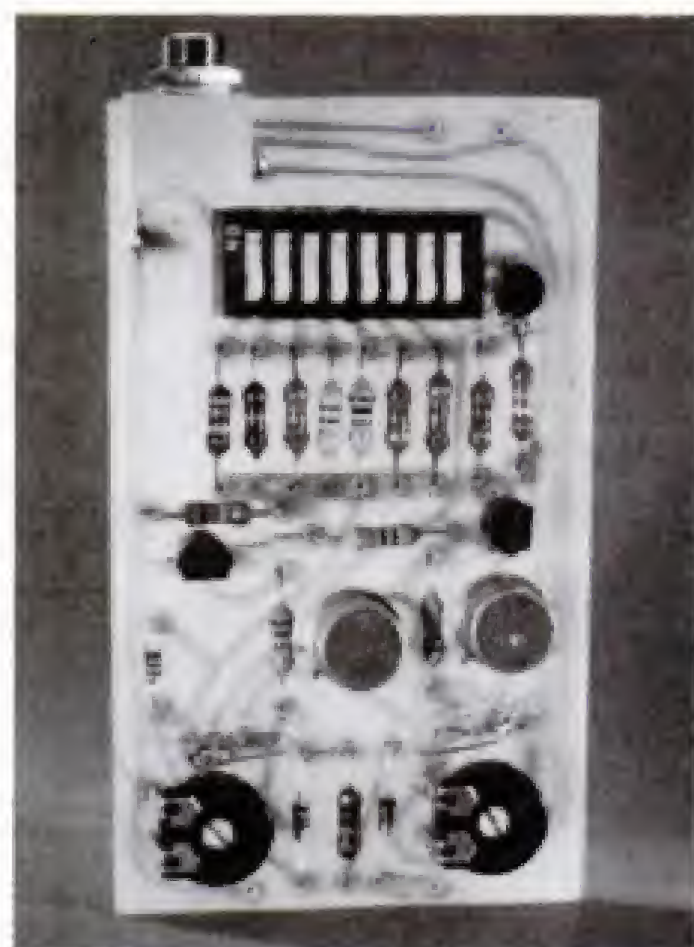
One of the best and most convenient sources for the 9 to 15 volts is one of the little modular, plug-in-the-wall battery eliminators. Since any 9- to 15-v. source will power the Battery Brain, you can also make an adapter that plugs into your car's 12-v. cigaret lighter.

Generally, it's best to recharge a battery when the voltage falls between 1.2 and 1.4. Normally, you can count on more than 10 recharges on such batteries as carbon-zincs, heavy-duties and alkalines. Nicads

are even better; they're designed to be recharged repeatedly and can go more than 1000 cycles.

Just as falling voltage indicates the state of discharge, how far the voltage rises toward 1.5 v. indicates how much charge the battery has taken. You adjust the cutoff trimmer control so the charging lights go

(Please turn to page 24)



Printed-circuit board has clean layout. We supply a template, or you can order board and complete kit (parts list, page 26).



'Tis the C.C. Season!

The Canadian Club gift package is available for holiday giving at no extra cost.
And now you can send gifts of C.C. by phone. Just dial 800-528-6148.

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Материал предоставлен компанией Hiram Walker Importers Inc.



Small Fridge. Big Deal. Save \$30 if you act now!

Order now for Christmas - and we'll extend our no-risk Trial period to January 15, 1981.

BEAT INFLATION! ELECTRONIC FRIDGES FROM \$99.

You've nicely gotten away on your long awaited vacation, camping trip or long week-end with the family. You're comfortably cruising in your car, van or rec. vehicle along a busy interstate with few rest stops or restaurants. You guessed it...the kids want to stop for a snack. But your Koolatron P34 or P34A is full of sandwiches, cold pop, fried chicken...home made, fresh and cold. The family helps themselves and you've saved valuable vacation time and another expensive restaurant bill.

You're a commuter, a salesman or a trucker and you spend many hours in your vehicle daily. You've often longed for a fresh snack or cold beverage as the miles tick away. Now with your amazing Koolatron P10 plugged in beside you, you open the lid and instantly fresh food and drinks are at your fingertips. You're refreshed...you've saved an unnecessary stop, time and money.

AFFORDABLE CONVENIENCE

Home refrigeration has come a long way since the days of the ice box and the block of ice. But most of us resign ourselves to doing without the same convenience once we leave our homes. Or, we revert back to the cooler and ice routine of days gone by, simply because there's never been any dependable and inexpensive alternative. But now, for the price of a good cooler and one or two seasons of buying ice, (or about 10 family restaurant meals), all the marvels of home refrigeration are available electronically. And the sloppy

ice cooler with its soggy and spoiled food can become a stone-age memory for you. An amazing space-age miracle...the thermo-electric solid state module...makes this portable refrigeration revolution possible.

AEROSPACE MODULES



These miniaturized thermoelectric modules replace all the bulky complex piping coils, compressors and motors in conventional portable refrigerators.

Utilized by NASA scientists, as the only refrigeration system for rockets and satellites, thermo-electric cooling has been in use for almost a quarter century. These expensive modules were selected by NASA for some basic reasons...they're small (about the size of your watch)...they're light weight (they weigh less than a package of cigarettes)...they're totally reliable (these modules are completely solid state and have no moving parts)...they require little power (they use the same power as one of your car's tail-lights)...they're completely insensitive to

tilting, bumping, vibration, (which causes failures to conventional compressors, motors and piping)...they're powerful (these modules have the same cooling power as a 10 lb. block of ice)...and they never wear out or break down. And for portable refrigeration where you require 12 volt DC. power, thermo-electric modules are the most efficient. These amazing heat pumps have not only gone to the moon, but have provided the breakthrough for Koolatron's truly reliable, lightweight portable refrigerators.

THOUSANDS IN USE

Koolatron Industries Limited now has tens of thousands of these electronic fridges in use worldwide using these same powerful solid state modules. The reliability, performance and convenience of electronic refrigeration has now been dramatically tested and proven in all kinds of temperatures, conditions and environments from Australia to Alaska. Built to take it, these electronic modules are encased in tough, plastic insulated chests that are designed to be rugged and trouble-free. Non-rusting hinges and latches prevent corrosion in salt water environments. And with only one moving part (a small 12 volt fan) Koolatron portables seldom see a service depot. Koolatron's combination of space-age heat pumps and quality engineering have now led to a whole family of electronic portable refrigerators and food warmers that eliminate costly ice and provide "home refrigeration" convenience at sane and sensible prices.

**MODEL P10-
THE PERFECT CAR FRIDGE
& FOOD WARMER**

\$189. \$99.00
(in Canada \$199. \$109.00)



Holds approx. 17, 12 oz. pop cans—refrigerates in air temps. up to 95°F. Also keeps hot foods hot (150°F) at the flick of a switch. Tough, blue Polypro plastic case. Ext. 16" L x 11" H x 11-1/2" W. Int. 11-1/2" L x 8" H x 8" W with 10 litre capacity (0.4 cu. ft.) weighs 10 lbs. empty. Operates from supplied 12 volt power cord in vehicles or with optional 12VDC/110VAC power adaptor.

Koolatron's P10 not only makes a great car fridge but at a flick of a switch lets you bring home your favourite fast foods "piping hot". Comes with a 9 ft. power cord that just plugs into your cigarette lighter. Amazingly easy to operate...one switch selects hot or cold. A second switch allows you to refrigerate normally or select maximum cold. With your engine off, you can operate several hours and still start your engine to recharge your battery. "A low battery" indicator warns you when it's time to recharge. With the power off, your P10 keeps everything hot or cold for many hours in its well insulated case.

As a travel fridge the P10 keeps your favourite foods and beverages fresh and cold wherever you go. If you're a salesman, your food samples will arrive perfectly hot or cold every time. If you carry insulin, medical samples, dietetic foods, your P10 will never leave your side. Great for private planes.

Photographers will find it invaluable for keeping expensive films from going bad. And mothers...now you can refrigerate baby's formula in your car then heat it with the flick of a switch. Powerboaters, just plug it into your boat's cigarette lighter, and keep a day's food and drink ice cold without running into shore for ice. You campers, hunters and fishermen will find endless uses for transporting provisions and bait...then take home your catches and game without spoiling. Terrific for golf carts.

And with our optional 110 volt adaptor you'll find endless uses wherever house current is available...At your cottage...as a bar fridge...in your motel room for a midnight snack and drink or as a small office fridge. Use as an auxiliary home fridge when you're having a party. And it's a natural at drive-in movies, auto races and at sporting events.

**MODEL P34-
THE STANDARD
RECREATIONAL FRIDGE**

\$189. \$139.00
(in Canada \$199. \$149.00)



Holds over 40 lbs. of food and beverages or 48 pop cans. Refrigerates in air temperatures up to 95°F. Rugged ABS case in sand beige colour with dark brown non-corroding latches and handle. Large 34 litre capacity (1.2 cu. ft.) weighs 17 lbs. empty. Ext. 21" L x 16" H x 16" W. Int. 16" L x 12" H x 11-1/2" W. Operates on 12 volts DC with supplied power cord or with optional 12VDC/110VAC power adaptor.

The P34 is our standard recreational size portable refrigerator. This new, improved model has a non-adjustable solid state thermostat which keeps your food at normal refrigeration temperature even in 95°F weather. It holds more than three times as much as the P10.

Imagine dry, dependable refrigeration with the size to match your travelling and camping needs. Fits into any boat, van or camper or back seat of your car. Plugs into your cigarette lighter receptacle and refrigerates over 40 lbs. of food (no space wasted by ice), yet it draws no more power than the P10. With our optional 110 volt adaptor, you'll find endless uses as a bar fridge, cottage fridge, office fridge. Your P34 has all the advantages of the P10 without the heating cycle or low battery indicator but with all the capacity needed for serious boaters, campers, hunters, fishermen and travellers.

**MODEL P34A-
THE DELUXE RECREATIONAL
REFRIGERATOR &
FOOD WARMER**

\$189. \$159.00
(in Canada \$199. \$169.00)



The same size, colour, weight and capacity as the P34 but includes food warming features, fully adjustable temperature control and low battery warning indicator.

The P34A is our top of the line portable. It heats, it refrigerates and with specially designed electronic circuit control (patent pending) it allows you to dial a complete range of temperatures from very cold to very warm.

Imagine the versatility. In season, refrigerate all your hunting, camping, boating and cottage provisions. Off-season, keep foods piping hot on your ice-fishing, skiing and snowmobiling weekends. You can even dial wine-cooling temperatures. Our low battery indicator warns you when you need a recharge and the sensing circuits efficiently control your power consumption to save on battery drain. This is our best of the line, recreational fridge and food warmer with all

READ WHAT OUR CUSTOMERS SAY:

"We took meat from Canada and ate it ten days later after thawing it in Florida. All our produce and drinks stayed unbelievably fresh and cool." SH, Hamilton, Canada

"The way I try to sell my refrigerator one would think I was on commission. We love our unit!" P.O.P., Houston, Texas

"The Koolatron is everything they say about it in its advertising. I personally bought one, tested it and found it so desirable that I gave it to my daughter and son-in-law who made a cross-country trek from Vermont to Oregon with their infant daughter. They told me that aside from their new Dodge van, the Koolatron was the most indispensable item of equipment they carried." K.M., New York, N.Y.

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Simply complete the attached order form or phone collect and we'll rush you your portable on our no risk 21 day trial offer. Each unit comes with complete instructions and a written 1 year warranty. In the unlikely event you ever need service, we have major service centres in New York, Arizona and Canada.

When you receive your Koolatron, use it constantly for 3 full weeks without risk. If you ordered our optional 110 volt adaptor, plug it in, then use your portable immediately as a bar fridge or around the patio or pool. Next plug it into your car or RV. Take your family out for a weekend trip. Enjoy fresh home cooked food as you thumb your nose at those expensive restaurant stops. Then use it on your boat or in your office or let your son or daughter try it at their college dorm. If after you've thoroughly tested it, you don't agree that your Koolatron represents a major breakthrough that will save you time, money and bother for years to come, send it back for a full refund. You can't lose...we guarantee it.

So be among the thousands to discover that the ice age is over! Don't waste another dollar on ice...order your Koolatron with no obligation, today!

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Or use this handy order coupon.

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Industries Limited

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Save me \$30 with these off-season prices:

- Koolatron P10 at \$99.00 (\$109.00 in Canada)
- Koolatron P34 at \$139.00 (\$149.00 in Canada)
- Koolatron P34A at \$159.00 (\$169.00 in Canada)
- Koolatron 110V adaptor at \$29.95 (\$34.95 in Canada)

Please add \$8.00 for handling and delivery per unit

No charge for shipping adaptor if ordered with unit

Add \$3.00 for shipping adaptor only

(N.Y., Ont. and Quebec residents add sales tax)

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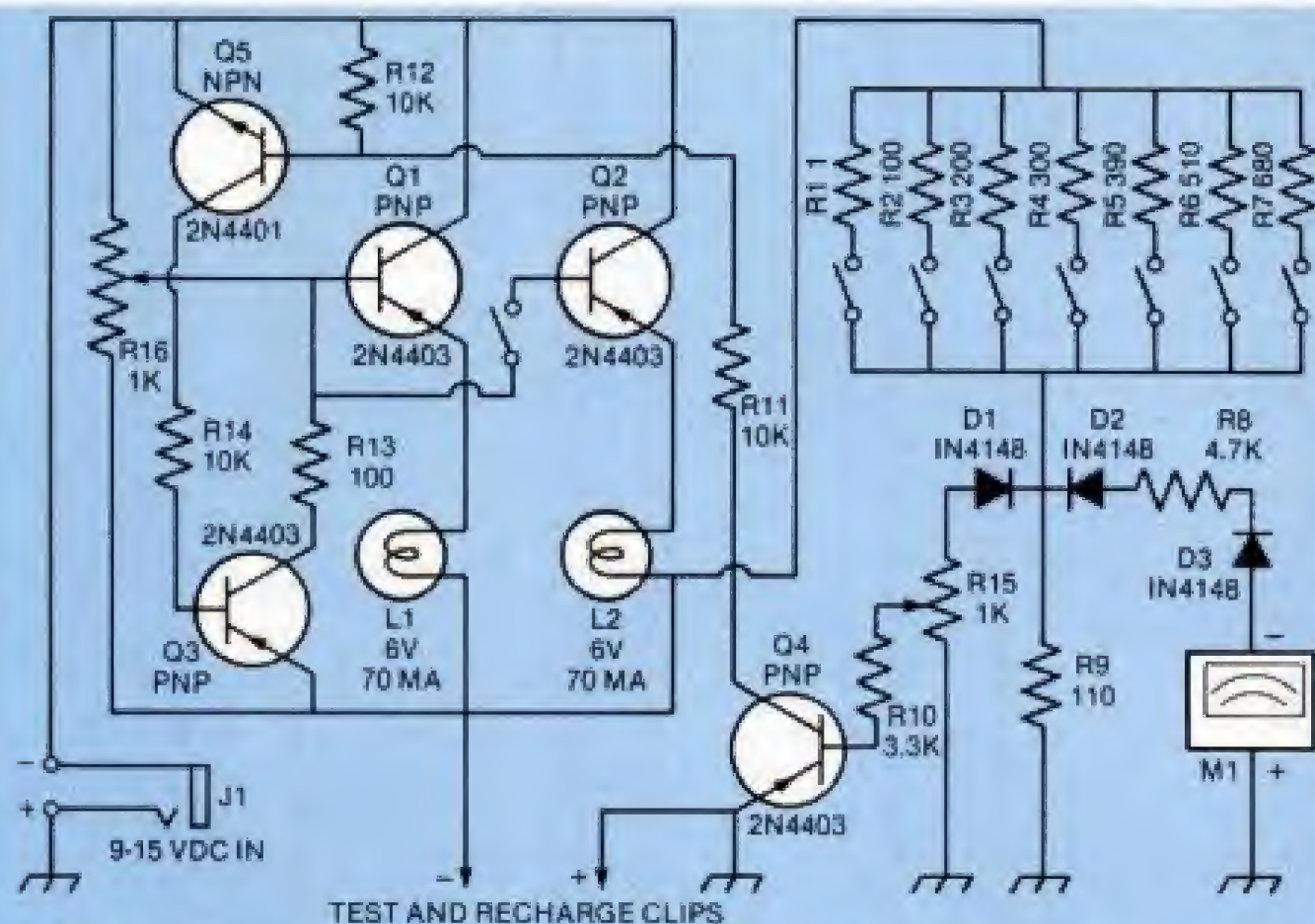
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BUILD PM'S BATTERY BRAIN (Continued from page 20)

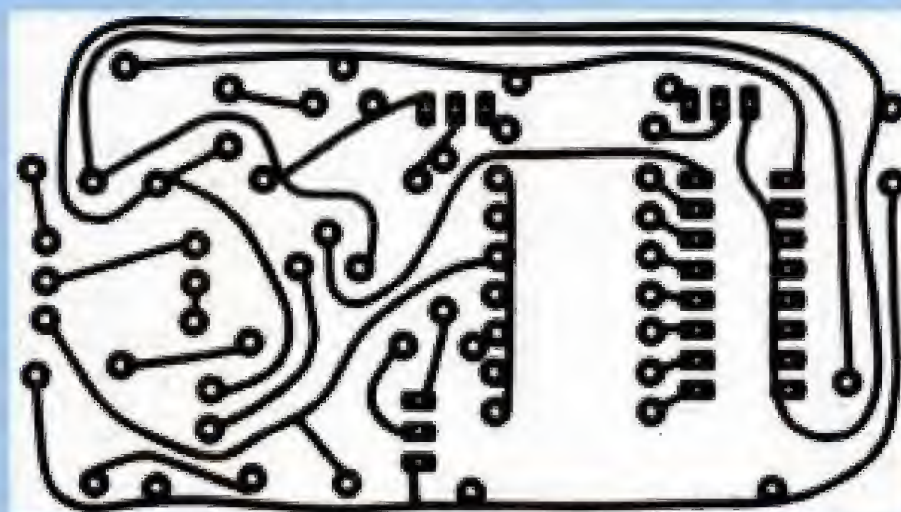
out just at 1.5 v. This way, the cutoff is set properly for all the different battery voltages you will use in charging.

Different-size batteries need different charge currents. The chart on page 26 shows the recommended

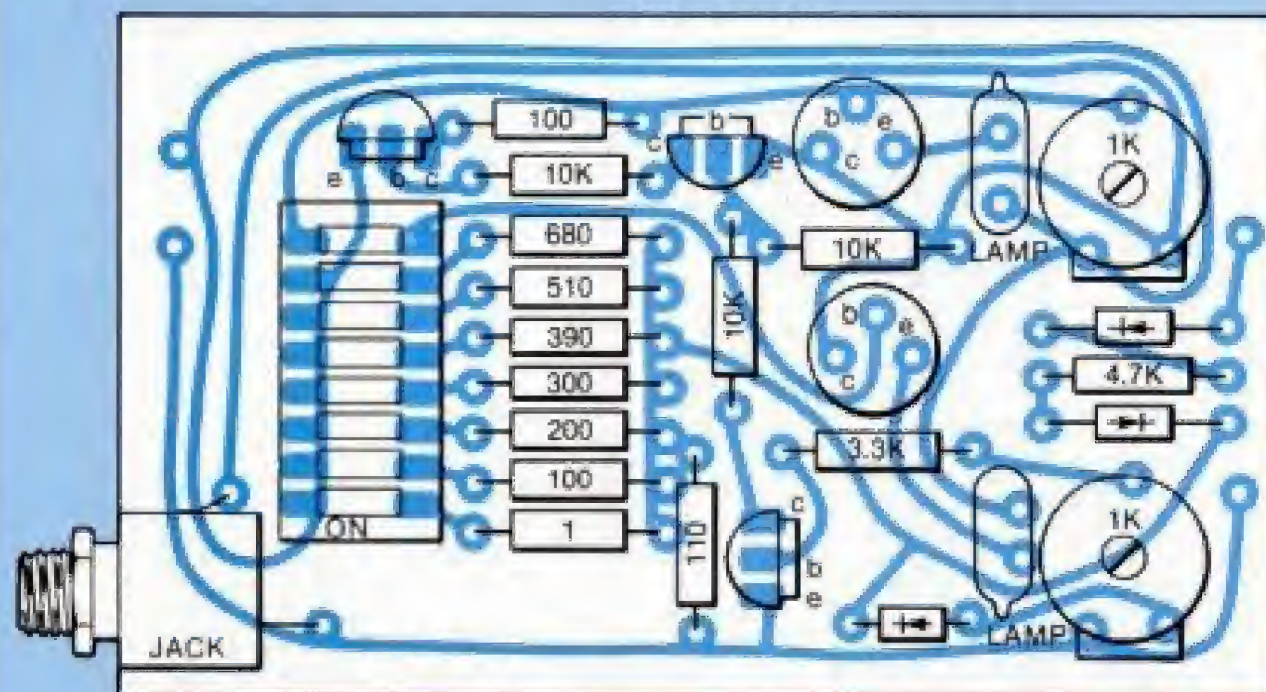
rates for various batteries. You set the current level with the charge control and judge by the brightness of the lights: Dim red=20 milliamperes (ma.); bright red=30 ma.; orange=50 ma.; yellow=60 ma.; (Please turn to page 26)



The schematic diagram (above) details how Battery Brain's components are interconnected. For complete list of parts required for the Battery Brain, see page 26.



Component-side view (below) shows how all the parts of the Battery Brain are to be placed on the printed-circuit board. You can easily make the PC board by using the template which is shown above.



Not Just Another Limited Area Motion Detector!

guardex™

Protects Every Square Inch Of Your Building

Turns On Lights Automatically

Powerful Electronic Siren



Low Cost Computerized Burglar Alarm System Home - Office - Business

NO INSTALLATION

Just plug the Guardex 8000 alarm system in, make two simple control adjustments to suit your particular building and it works! There are no other wires to run. This totally self-contained burglar alarm can completely seal off every square inch of the surface of your building. It protects doors, windows, and what most alarms miss... your roof, walls and floors.

HOW CAN ONE SMALL COMPUTER PROTECT MY WHOLE BUILDING?

Guardex 8000 Alarm System works on the principle of audio discrimination. This, put simply, is the process of electronically separating normal everyday sounds, such as voices, telephones, etc. from break-in type noises such as breaking glass, prying metal, or forcing a door open. The Guardex 8000 protects one story homes and offices up to 2000 square feet and open commercial buildings up to 10,000 square feet. The Guardex 9300 with wireless remote sensor capability is available for multi-story homes and offices or single story with more than 2000 square feet. Call the factory for more detailed information.

TURNS ON LIGHTS AUTOMATICALLY

When the first break-in type sound is detected, the system will instantly turn on lights, radio, or other electronic equipment that you have plugged into the back of the alarm. These lights or other equipment will remain on for a period of five minutes, then automatically turn off.

POWERFUL ELECTRONIC SIREN

The Guardex 8000 alarm is equipped with a loud built-in siren. If during the five minute period the lights or other electronic equipment has been activated, a second break-in sound is detected, (it can be only a second or two after the first break-in sound) the built-in siren will start blasting for 90 seconds. At the end of approximately 90 seconds the siren will shut off and the alarm listens again. If another break-in sound is heard, the siren will come on for another 90 seconds. If no other break-in sound is detected, the siren will stay off and at the end of the five minute period the lights will shut off and the alarm instantly resets.



The rear control panel contains two standard AC plug receptacles for a table lamp, spot lights, radio, etc., terminals for connecting optional outside siren and back-up battery (not included); entry delay time control and sensitivity control.

The Guardex 8000 Alarm System is walnut grained and disguised to look like a small stereo speaker (6 3/4" x 9 3/4" x 8") and weighs less than 6 1/2 pounds.

EXIT AND ENTRY DELAY

The Guardex 8000 alarm has a built-in exit delay allowing you approximately one minute to lock up and leave the building before the alarm is armed. When you enter your building you may find that just your normal entering sounds activate the siren. You may delay it from starting for up to 30 seconds by turning up the siren entry delay control.

BATTERY BACK-UP

Burglars rarely cut power. However, to give you total protection from a burglar and possible power failure, our alarm has provisions for a battery back-up. (Batteries not included). 12 volt lantern batteries are available at most hardware stores.

THE BURGLARY PROBLEM

The F.B.I. statistics show that at the present rate, one out of every four Americans are going to be burglarized. That is not a very pleasant fact, but it is true. You have a greater chance of being burglarized than being a victim of a fire or automobile accident. The time is now to help protect yourself and your valuables with a Guardex 8000 alarm system.

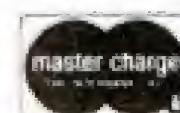
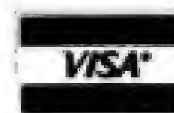
OUTSIDE SIREN

The Guardex 8000 alarm is equipped with a loud, built-in siren, but if you desire an additional siren to mount outside or in an area away from the main alarm, they are available with 50 feet of wire for \$24.95. (Connecting terminals are provided on the back of the alarm).

30 DAY NO RISK TRIAL

This is your opportunity to purchase an alarm system directly from the factory for only **\$199.95**. Try it in your home or business for thirty days without risking one cent. Put our Guardex 8000 alarm to your own test. See for yourself! It will protect every window and door from break-in. If you are not completely satisfied, return the alarm within 30 days for a complete refund. To order your Guardex 8000 alarm, **CALL TOLL FREE** to charge your credit card or send your check to Guardian Electronics, Inc. in the amount of \$199.95 plus \$3.50 postage and handling. If you want the optional outside siren, add \$24.95 (California residents add 6% sales tax.)

(If you require more information, call during California business hours, Monday - Friday).



Dealer Inquiries Invited

CALL TOLL FREE
(800) 423-5499

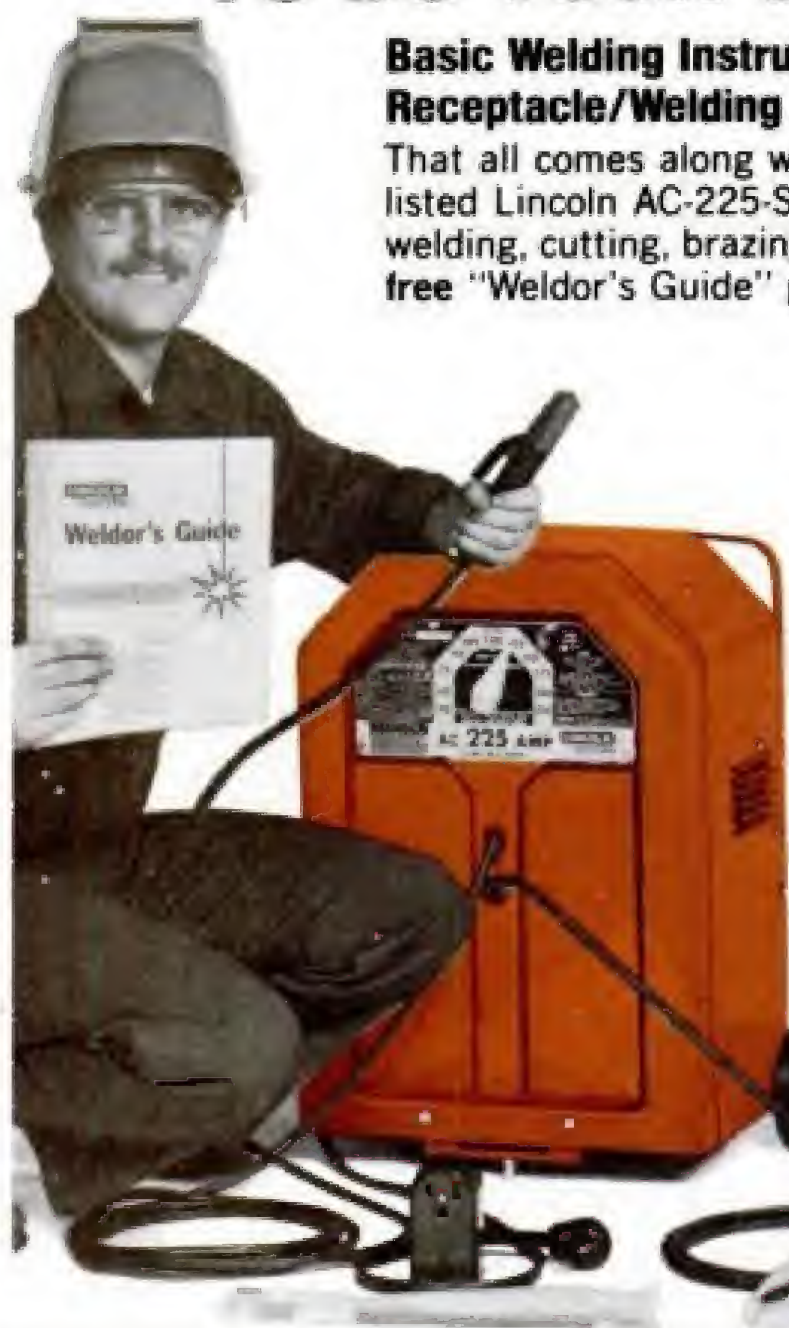
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NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

LINCOLN
ELECTRIC

BUILD PM'S BATTERY BRAIN

(Continued from page 24)

white= 70 ma. These values are doubled when you flip the "C" switch. So you get a charge current range of 20 ma. to 140 ma.

Construction

Construction is easy if you order our kit. You install and solder all the components on the drilled, etched and labeled printed-circuit (PC) board. If you prefer to make your own PC board, we supply a template on page 24.

Resistors R1 through R7 divide the different battery voltages down to 1.5. Which one is in the circuit is selected by one of seven switches. Before the meter gets the voltage, the "unwanted" 0.9 v. is subtracted out by diodes D2 and D3. The circuitry on the left shuts off the charge current (which flows through the lamps) when the voltage per cell of the battery you are charging reaches 1.5 v.

Note: In order for your battery to get a charge, the voltage of your source has to be higher than that of your battery. So if you are charging 9- or 12-v. batteries, you need at least a 12-v. or higher source. **PM**

RECHARGE YOUR BATTERIES

Percent of energy remaining in carbon-zincs and alkalines for various voltages:

Recommended charge currents for different-size battery cells:

1.5=100%	AAA	20 ma.
1.4=85%	AA	40 ma.
1.3=65%	C	60 ma.
1.2=35%	D	100 ma.
1.1=20%	9-v.	10 ma.
1.0=10%	Lantern	140 ma.
0.9=0%		

PARTS LIST—BATTERY BRAIN

All resistors are 1/4-w. carbon unless otherwise specified.

- R1—1-ohm resistor
- R2—100-ohm resistor
- R3—200-ohm resistor
- R4—300-ohm resistor
- R5—390-ohm resistor
- R6—510-ohm resistor
- R7—680-ohm resistor
- R8—4.7K (4700-ohm) resistor
- R9—110-ohm resistor
- R10—3.3K (3300-ohm) resistor
- R11—10K (10,000-ohm) resistor
- R12—10K (10,000-ohm) resistor
- R13—100-ohm resistor
- R14—10K (10,000-ohm) resistor
- R15—1K adjustable trimmer control
- R16—1K adjustable trimmer control
- Q1—2N4403 PNP transistor (TO5 case)
- Q2—2N4403 PNP transistor (TO5 case)
- Q3—2N4403 PNP transistor (92 case)
- Q4—2N4403 PNP transistor (92 case)
- Q5—2N4401 NPN transistor (92 case)
- D1, D2, D3—1N4148
- M1—0-200uA edge meter
- S1—S8—8-position DIP switch
- L1, L2—6-v., 70-ma. lamp
- J1—Jack, open-circuit type
- Misc.: Wire, clips for batteries, solder.

Note: A complete kit of parts for the Battery Brain is available from Circuit Craft Inc., 10 Idell Rd., Valley Stream, N.Y. 11580, for \$14.95 postpaid (includes everything listed above). A completely assembled Battery Brain is available for \$19.95 postpaid. A plug-in-the-wall, 15-v., modular power source is also available separately for \$7.95 postpaid.

LYNCHBURG HARDWARE & GENERAL STORE

42 Main St., Lynchburg, TN 37352



Old-time Riverboat Playing Cards

Both of these decks are prettier than a painting, and so is the antique tin card case. Each card is a bit larger and thicker than normal—like those used on riverboats in the 1890's. There's a black and a green deck—both with an antique gold "distillery design." The face cards are reproduced from 100-year-old artwork. So it's a real unusual set of cards for the serious player. Twin deck in antique case: \$8.50. Postage included.

Send check, money order, or use American Express, Visa or Master Charge, including all numbers and signature.

(Tennessee residents add 6% sales tax.) For a color catalog full of old Tennessee items and Jack Daniel's memorabilia, send \$1.00 to above address.

A beautiful and better way to heat with wood



Hearthstone
America's Quality Soapstone Stove

- **Unique soapstone construction** — retains and radiates a more pleasant, even heat throughout your home.
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- **Safer heat** — our unique Secondary Combustion System reduces creosote build-up — even at low burn rate.
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- **Can heat an entire house** — used as the sole heat source in many homes.
- **Built to last for generations** — completely handcrafted in limited production.
- **Available in top or rear flue models.**
- **Reserve your stove now** — demand has production booked months ahead!

Send \$1. for handbook to: **Hearthstone**, Dept. PM11, Morrisville, VT 05661. Toll Free: 800-451-5211 VT: 888-4586.

Now they save gas.

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What's more, it's the same quality Pennzoil you've been using all along to protect your engine. Only now it saves gasoline—and in the weights people use most, 10W-30 and 10W-40.

Gas-saving Pennzoil. Now you don't have to pay extra to get extra miles.

Ask for it.

Gas-saving Pennzoil

QUALITY IN EVERY EXTRA MILE





*The pleasure
is back.*



BARCLAY

99% tar free.TM

*Kings
100's*

Kings, 1 mg. "tar", 0.2 mg. nicotine;
100's, 3 mg. "tar", 0.4 mg. nicotine
av. per cigarette by FTC method.

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

ALL OUTDOORS

What's up with down

Outdoorsmen once again this year will be the style leaders in winter wear. The overstuffed look of down insulation in clothing continues to be the popular one, and many non-sporting types as well will be dressed up with gear more suitable for an Alpine expedition.

Though not as practical or economical as some of the new synthetics, down fuzz from waterfowl does have great properties of lightness, compressibility and heat retention. Unfortunately, it has also been in short supply, and some "feather merchants" have been adulterating it with assorted feather quills, fibers and findings that do little to keep you warm.

So the Federal Trade Commission has stepped in with specifications for what can be called "down," and what the ads and labels can and cannot say. There is, for instance, no

fowl feathers and fiber, and 2 percent residue.

A mix called "90-percent" may have 63 percent plummets, 9 percent down fiber, and the remaining 28 percent other feathers and residue. This so-called 90-percent mix, or any lesser combination, can't legally be named down.

Down loses its insulating ability when it gets wet, dries slowly, has to be puffed up to hold heat and needs special sewing to keep it in place. Because of these disadvantages, it probably is not as practical as less expensive synthetics. But if you buy down, be sure to read the label to learn what's inside and who made it. Well-known, established manufacturers are still the best sources to get what you're paying for.

Marine machine

The hottest new offshore speedboat of 1981 is going to be the Squadron



High-performance, 27-foot Squadron XII is latest design from famed racer Don Aronow.

such thing as "Pure Down." It is also illegal for a manufacturer or dealer to claim he's selling you clothing, sleeping bags, gloves or whatever filled with "100-percent Down," "All Down," "Northern Down" or "Prime Down." Areas of origin are impossible to prove, and all down is a blend, with proportions specified by the FTC. These figures are confusing, but here's how they add up:

To be called a down garment, the insulation in it must contain established percentages of down plummets and down fiber. Plummets are the essence of down, and are tiny pom-pom-shaped balls of feather fuzz. A waterfowl fluffs them up to stay warm. True down must have an 80-percent combination of down plummets and down fiber, with a minimum of 70 percent of plummets and a maximum of 10 percent of down fiber. The remaining 20 percent of true down is down fiber, waterfowl feathers and fiber, with not more than 2 percent of nonwater-

XII. You won't see many. They will be the very limited production of a new company founded by world champion racer Don Aronow of North Miami Beach, Fla. Previous winning creations of his carry the names Formula, Donzi, Magnum and Cigarette.

His most recent high-performance design, with a 400-hp MerCruiser Cyclone engine in a 27-foot hull, is reported to top 62 mph and match competitive twin-engine models, but with a saving of 35 percent in fuel.

If you don't happen to have around \$35,000 for one right now, at least the Squadron XII will be the new one to watch.

Glide ride

One more development toward smoothing out the moguls along the snowmobile trails is called a Ski-Doo 5500MX with "total suspension." Shock absorbers on both front skis, plus a rear slide-suspension system,



Newest Ski-Doo has four-way suspension.

give improved response to bumps. Stress and stabilizer bars on the front-ski shock absorbers help damp the ride, and the dual rear shocks allow nearly a foot of vertical travel. Individual adjustments of each shock are said to allow tuning for both trail conditions and the weight of the driver.

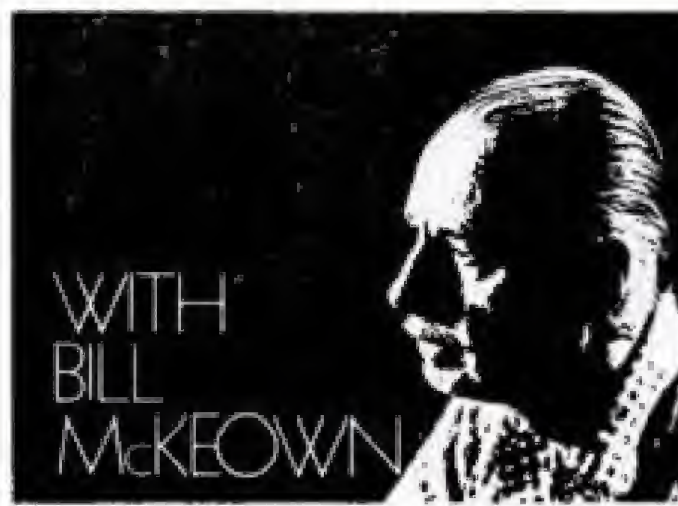
For the snowmobile driver who also likes to tinker, tune and treat his favorite machine with TLC, *The Collected Works of Pappy* is now available.

Prepared with some assistance from racing reporter and technical columnist John Ramstad, the book has a wealth of two-cycle maintenance tips, plus many cheerful comments on other sports, as well. For \$5, it comes postpaid from The Permanent Press, 2018 Milwaukee, Minneapolis, Minn. 55404.

Action items

The Coast-to-Coast HikaNation trek from San Francisco, organized to help promote hiking trails, is expected to reach Washington, D.C., late next spring.

If you want to hike segments of the route with the group, call the American Hiking Society at (305) 251-0484. It's a 24-hour number sponsored by Postum, a supporter of the hike, which gives information about where to join the group and its present location. **PM**





Every Party's Choice.

No matter how you mix it, Seagram's 7 Crown's a winner.
 7 & Cola with a slice of lime? Triumphant! 7 & 7? Victorious!
 Even all by itself over ice, it's unbeatable!
 And enjoy our quality in moderation.

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AMERICAN WHISKEY - A BLEND. 80 PROOF. SEAGRAM DISTILLERS COMPANY, N.Y.C.

Manufactured by Seagram Distillers Company, N.Y.C.

NEW CHEV AN IMPORTANT

**Less weight. More miles per gallon.
New lean look. More payload.**

Chevy Pickups take an important step ahead for 1981. A new aerodynamic shape cuts power-robbing air drag. Weight has been trimmed without sacrificing toughness. You get new efficiency plus Chevy's tough truck build.



New Electronic Spark Control V8. Improved Six. An optional 5.0 Liter (305 Cu. In.) V8 with Electronic Spark Control offers surprising horsepower for an engine its size. Operates on low octane, unleaded fuel. (ESC not available in California.) The 4.1 Liter (250 Cu. In.) Six has a recalibrated carburetor for smooth operation.

Payloads to 2559 lbs. on C10 models. More than last year. Payload includes driver, passengers, equipment and cargo. C10 GVWRs up to 6100 lbs.

New 4-wheel-drive system. And more. Chevy K10 and K20 4-wheelers use a new system with automatic locking front hubs that can be shifted into and out of 4-wheel drive without leaving the cab. Chevy Pickups also offer new interior comfort, same roomy cab, and more. Ask about leasing, too.

4.1 LITER (250 Cu. In.) SIX

19 EPA
EST.
MPG

25 EST.
HWY.

Remember: Compare the "estimated MPG" to the "estimated MPG" of other vehicles. You may get different mileage, depending on how fast you drive, weather conditions and trip length. Actual highway mileage will probably be less than the estimated highway fuel economy. Lower in California. (Mileage improvement does not apply in California.)

Features that were too good to change.

- ☐ Massive Girder Beam front suspension on 2-wheel-drive models
- ☐ Double-wall construction
- ☐ Computer-matched brake systems
- ☐ Strong steel frame
- ☐ Two-stage, multi-leaf rear springs
- ☐ Counter-angled rear shocks
- ☐ High Energy Ignition system



Chevy trucks are equipped with GM-built engines produced by various

Motorcraft, licenciado a la venta en el mercado.

Y TRUCKS T STEP AHEAD



visions. See your dealer for details.

Chevy C10 Pickup with optional Silverado trim.

Illustration, drawing, and photo are not to scale.

**Trooper-tested
Protection.**

**Unbeaten
Mileage.**



**The two things
you want from your motor oil
are both in
Texaco's Havoline Supreme.**



Indy 500 race car driver Janet Guthrie knows that, today, drivers like you want more than a motor oil that just protects your engine.

You're also looking for a fuel economy tested oil. That's why Janet recommends that you use Havoline Supreme. Texaco's Havoline Supreme is the 10W-40 motor oil with a special friction fighter that's been proven in fuel economy tests. In fact, extensive tests showed that two leading 10W-40 motor oils advertising "extra gasoline mileage" couldn't beat Havoline Supreme.

What's more, in over a million miles of rugged state trooper testing, it delivered proven engine protection, too. Up-front protection backed by unbeaten mileage—two supreme reasons why you should change to Havoline Supreme.



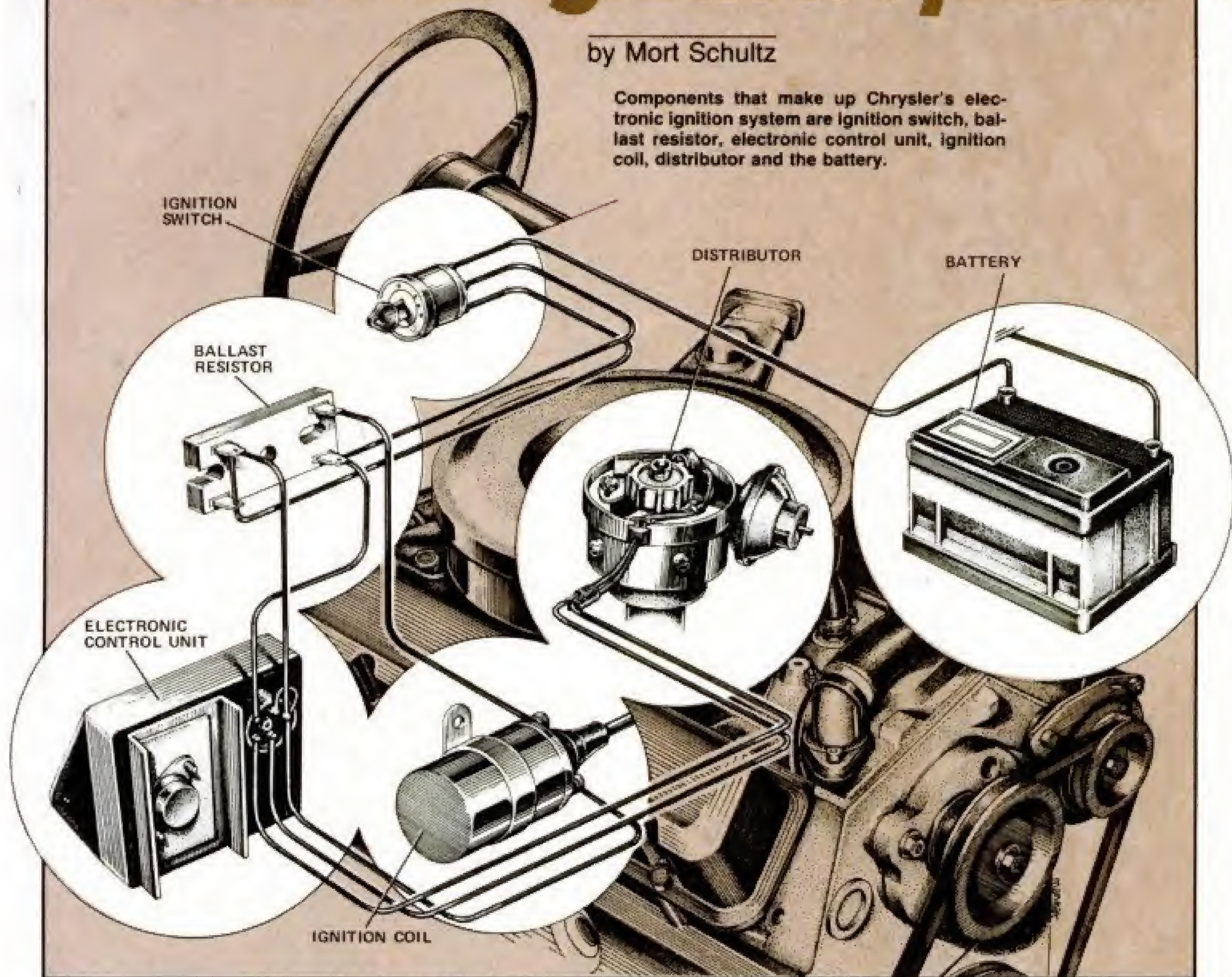
Trust your car to the products with the Star.

Motorists should always use the proper oil for their engine.

Servicing Chrysler's electronic ignition system

by Mort Schultz

Components that make up Chrysler's electronic ignition system are ignition switch, ballast resistor, electronic control unit, ignition coil, distributor and the battery.



In 1971, Chrysler Corp. began the trend toward electronic ignition (EI) by installing it in passenger cars. Since then, all American and most foreign manufacturers have adopted the more reliable EI system in preference to conventional break-point ignition.

Unlike conventional ignition systems—which have moving parts that wear, lose adjustment and fail within a relatively brief period—EI systems are practically all solid state. Parts need not be adjusted often, and they serve for years before they need to be replaced.

However, the time for replace-

ment is inevitably reached. For earlier-model Chryslers, it's probably just about now.

The question you probably ask yourself is, "Do I turn my car's EI over to a professional or should I do it myself?" We say: "Do it yourself!"

Testing and repairing the EI system are within the province of the Saturday mechanic, as PM readers who own GM EI-equipped cars learned in September (see *Repairing the General Motors High Energy Ignition System*, page 35, Sept. '80). Now it's your turn to find out how it's done, if you happen to own

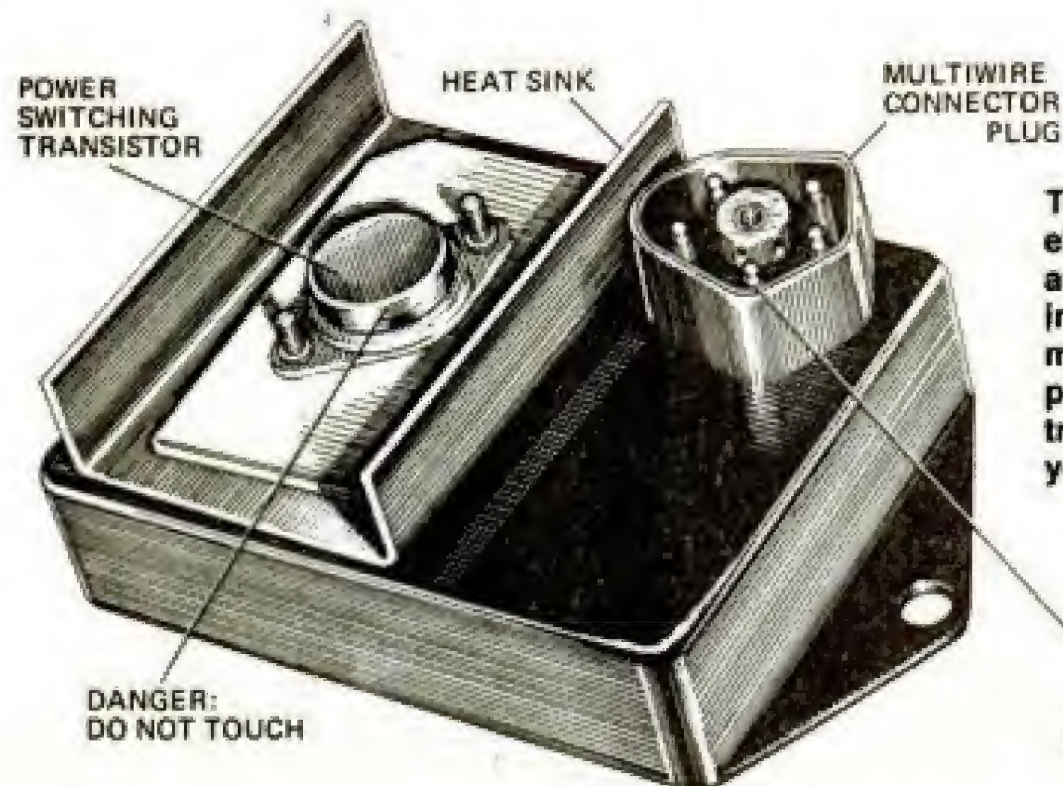
a Chrysler, Dodge or Plymouth.

Other than sparkplug and sparkplug-cable maintenance, don't service an EI system unless there's a chance that an engine problem is a result of ignition-system failure.

When an ignition malfunction occurs, ignition-system failure is either complete or intermittent. With complete ignition failure, the engine won't start.

With intermittent failure, spark is produced, but not at all plugs. The engine, therefore, will be hard-starting. If it is running, it will falter (miss), but will continue to run.

When complete or intermittent



The main parts of the electronic control unit are the power-switching transistor and the multiwire connector plug. Don't touch the transistor. It will give you a severe shock.

failure strikes an EI system there's a good chance that secondary circuit-handling (high-tension) components are at fault. Your initial inspection should be for sparkplug, sparkplug-cable, distributor-cap and distributor-rotor damage. If these check out okay, turn your attention to the electronic components.

Caution: If you have a Chrysler service manual, don't rush to buy Chrysler's Electronic Ignition Tester C-4166 and Adapter C-4166-1 that the manual recommends for testing. The ordinary voltmeter and ohmmeter you probably have in your toolkit will serve nicely.

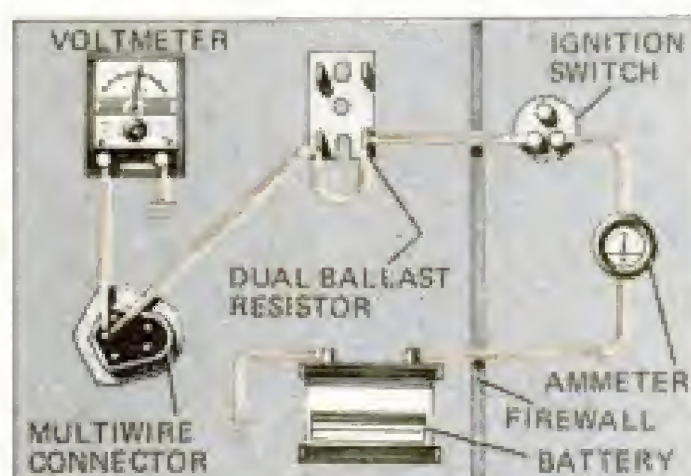
Chrysler uses three major variations of its EI system in 1971-80 federal cars (those not for sale in California). For easy reference, let's call them the Basic System, Spark Control Computer System (also called the Lean Burn System) and the Hall Effect Distributor System.

The Basic System is used in cars having six- and eight-cylinder engines. Models built from 1976 to 1980 may or may not be integrated with the Spark Control Computer System. The Spark Control Computer System is a Chrysler innovation that is more an emissions-control system than an ignition system. The Hall Effect Distributor System was instituted on 1978 models equipped with four-cylinder engines, notably Horizon and Omni. The distributor differs from the one used in the Basic System.

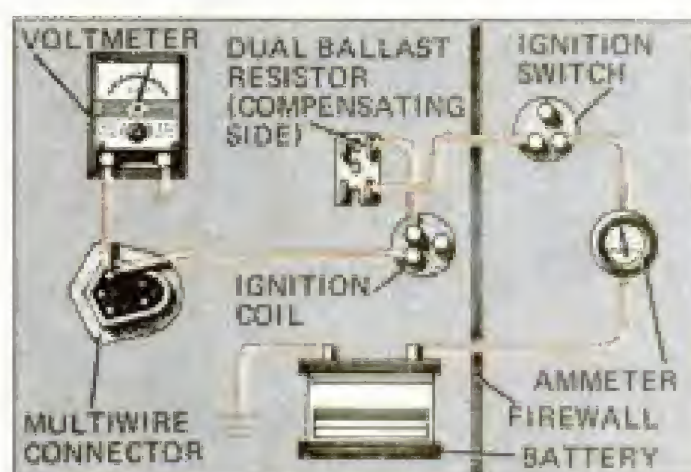
Testing information that follows concerns troubleshooting and repairing the Basic Chrysler EI System. Future Saturday Mechanic articles will cover the other two.

Testing the Basic System

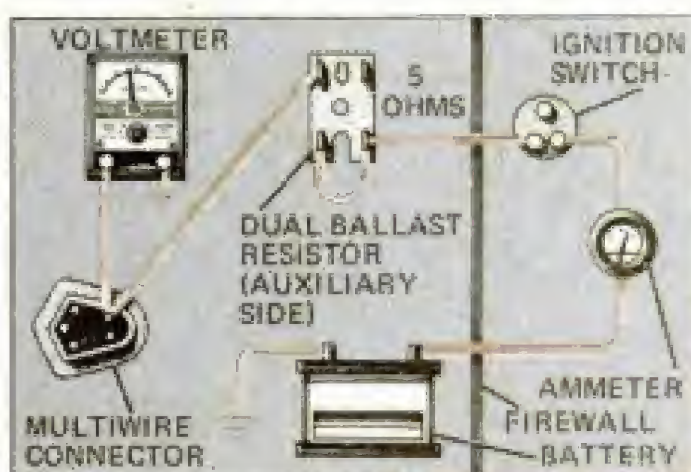
Locate the components that make up the Basic System. They are the electronic control unit, dual ballast resistor, distributor and ignition coil.



Test No. 1: Voltage should be ± 1 volt.



Test No. 2: Voltage should be ± 1 volt.



Test No. 3: Voltage should be ± 1 volt.

Meter checks illustrated in tests 1, 2 and 3 are made at the pins of the multiwire connector, not at the pins of the plug on the electronic control unit. Clean the connections if they are dirty.

Readings at the dual ballast resistor (right) should be as shown in the illustration.

Here's a warning about something before you start working on your car. Notice that bright metal "button" sitting in the middle of the electronic-control-unit heat sink? It's a power-switching transistor and has a lot of juice going through it when the ignition switch is turned on. Don't touch it. You'll get shocked to your socks.

Here's how to trace an ignition problem in Chrysler six- and eight-cylinder models equipped with a Basic EI System:

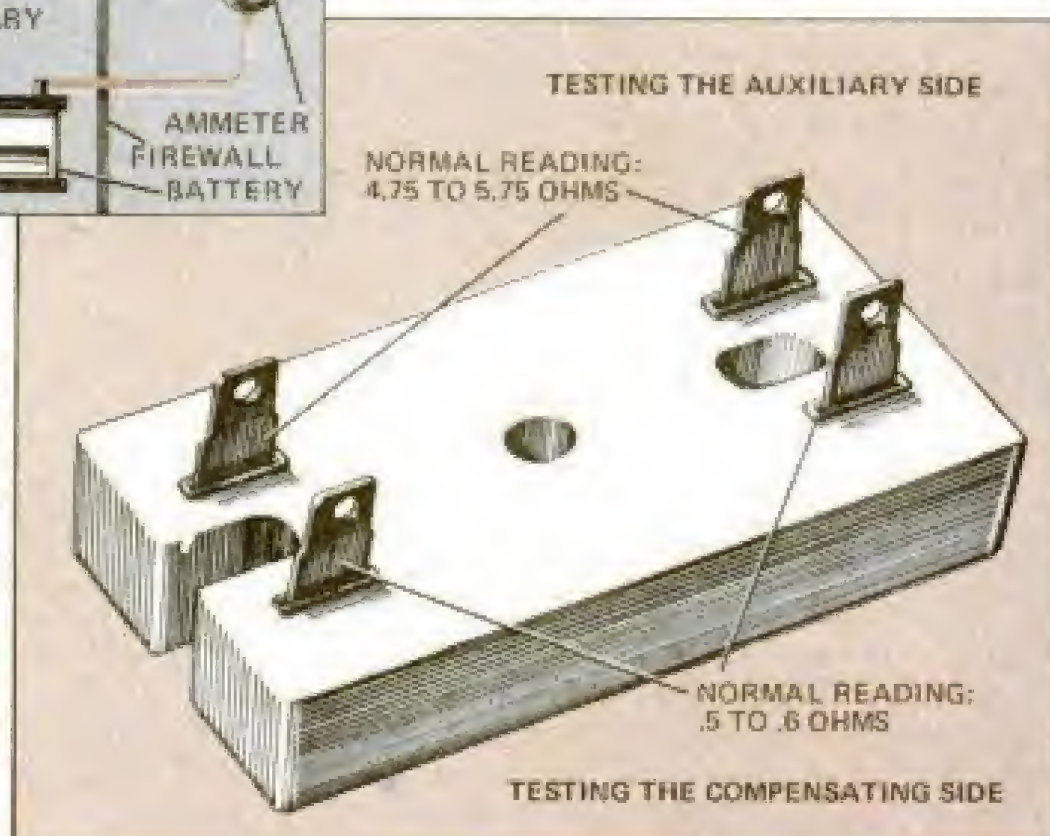
■ Connect a voltmeter, turn ignition to START and test battery voltage. It should be at least 12 volts. If not, charge the battery.

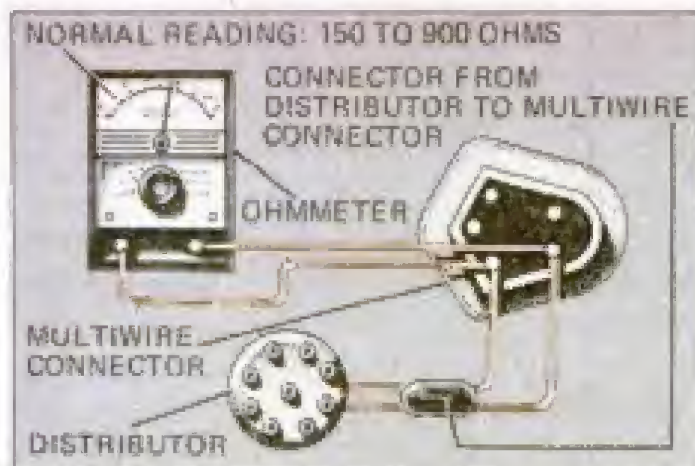
■ With the ignition switch and all accessories turned off, grasp and pull the multiwire connector from the plug of the electronic control unit. Using a voltmeter, do the following tests at the cavities of the multiwire connector:

Caution: Tests are done with the ignition switch turned on. Make voltmeter connections with the ignition switch turned off. Then turn it on to get the test reading, but turn the switch off when done.

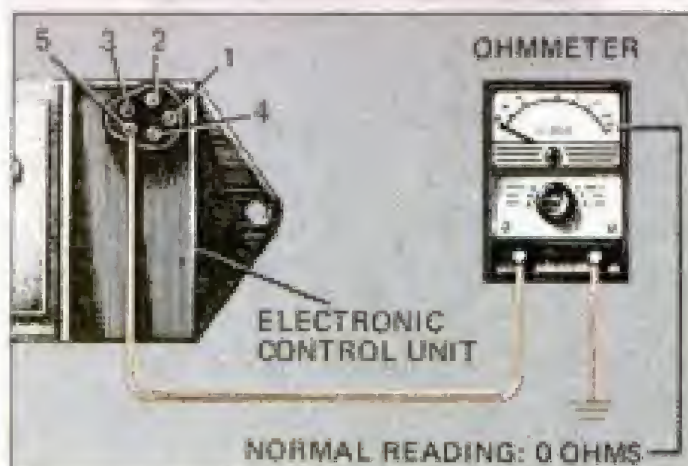
1. Connect the positive lead of the voltmeter to cavity No. 1 and the negative lead of the voltmeter to ground. Turn the ignition switch on. The voltmeter should read battery voltage ± 1 volt. If the reading is not within this range, inspect the wiring connections shown in the diagram for test No. 1. They should be clean and tight.

2. Do the test again, this time moving the voltmeter positive lead to cavity No. 2 of the multiwire connector and then to cavity No. 3. (In 1980 models, there is no cavity in the multiwire connector that coincides with cavity No. 3 in multiwire connectors of previous-year models.) Normal test specifications are the same as with cavity No. 1—battery voltage ± 1 volt. If you don't get this reading

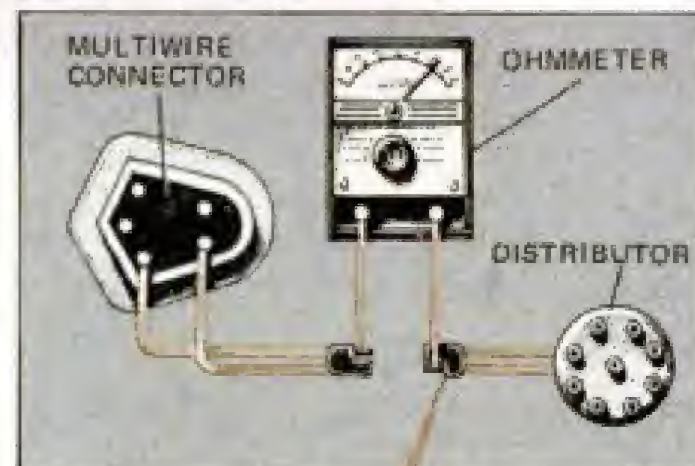




Test No. 4: Should read 150 to 900 ohms.



Test No. 5 (above): Should read 0 ohms.
Test 6 (right): Should be 150 to 900 ohms.



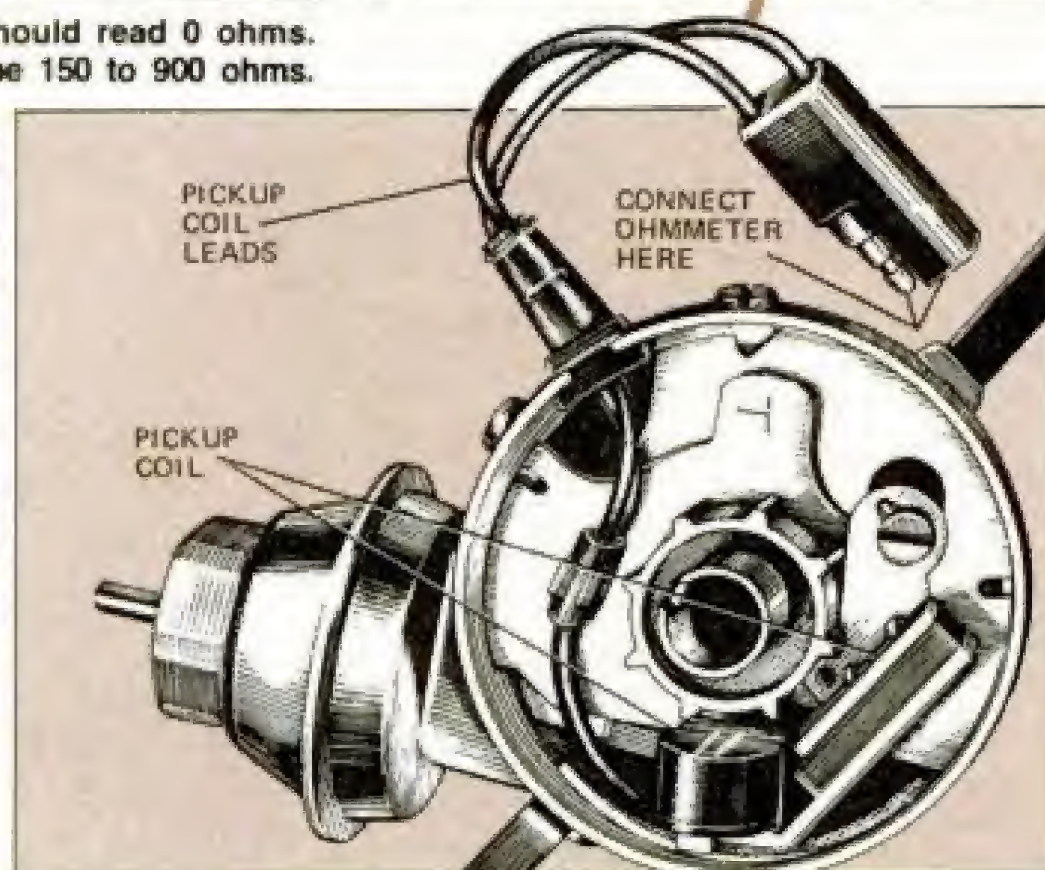
from one cavity or the other, inspect the wiring connections as shown for cavity No. 2 (diagram for test No. 2) or for cavity No. 3 (diagram for test No. 3).

Now, suppose in testing cavity No. 1 you got a voltmeter reading that wasn't normal, but wire connections are clean and tight. The system may have a defective dual ballast resistor.

As the name implies, the dual ballast resistor is two resistors in one. One side of the unit, called the compensating side, is a 0.5-ohm resistor. This side maintains primary current at a constant level, although engine speed varies. When the engine is cranked, current bypasses this part of the ballast resistor so that full battery voltage can be applied to the ignition coil. (In 1980 models, a 1.2-ohm resistor is used instead.)

The other side of the dual ballast resistor, called the auxiliary side, is a 5-ohm resistor. Its job is to protect the electronic control unit from receiving excessive current. Testing the dual ballast resistor is done with the ignition switch turned off. Before disconnecting wires from the ballast resistor, identify them in relation to the terminals to which they connect. You may, for example, wrap masking tape with different numbers around the wires and note the corresponding numbers on the

Tests 4, 5 and 6 must be performed with the ignition switch turned off. In test No. 6, the ohmmeter connections should be made to the distributor pick-up-coil plug, as shown at right. Before making the above tests, make sure all connections are tight. If any dirt or rust is present, be certain to clean off the connections before making the tests.



ballast resistor beneath the terminals.

Connect an ohmmeter across the two top terminals. Record the reading. Then connect the ohmmeter across the two bottom terminals. Record the reading.

The compensating (0.5-ohm) resistor is usually on top and should show a reading of 0.5 to 0.6 ohms. The auxiliary (5-ohm) resistor is usually on the bottom and should show a reading of 4.75 to 5.75 ohms. If either of the readings is not within specifications, replace the ballast resistor.

If a reason for ignition failure has not been uncovered so far, test the pickup coil, which is in the distributor. The ignition switch should be off.

Connect the ohmmeter between cavities No. 4 and No. 5 of the multiwire connector, as shown in the diagram for test No. 4. You should get a reading of 150 to 900 ohms. If you

don't, pull apart the connection that hooks the distributor to the multiwire connector. Attach an ohmmeter to the connector on the distributor, as shown in the diagram for test No. 6.

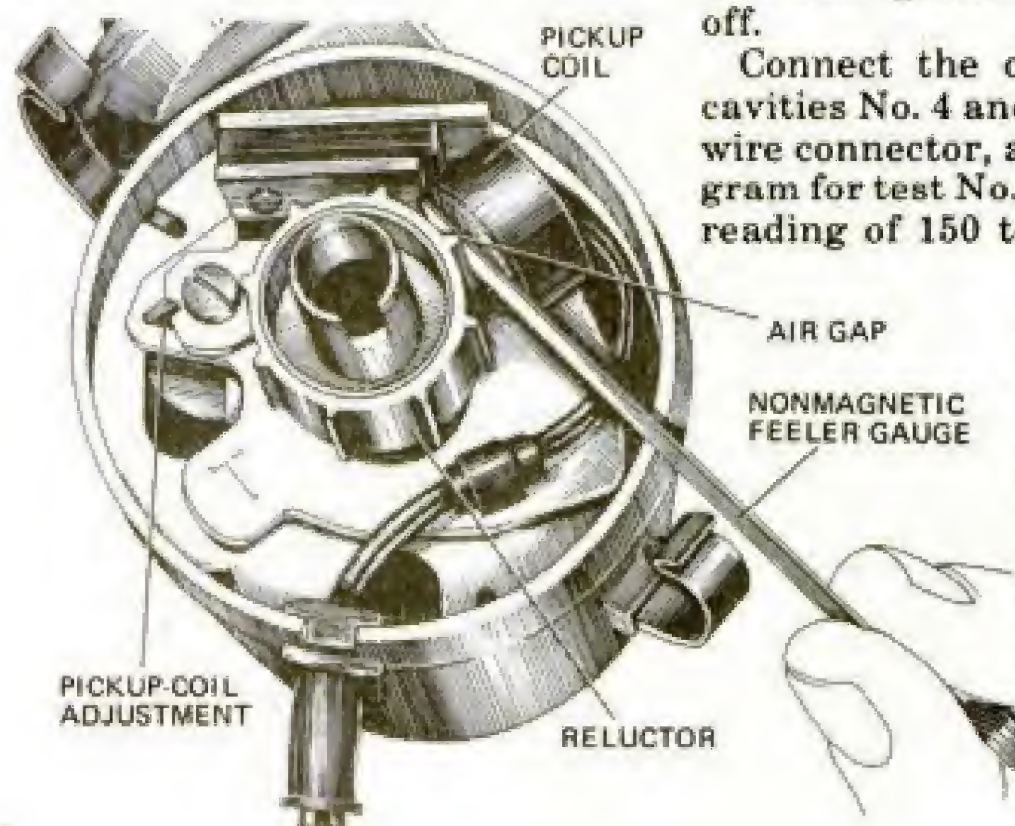
If the ohmmeter now gives a reading of 150 to 900 ohms, reconnect the two parts of the connector *tightly*. A loose connector is the cause of your problem. But if the ohmmeter reading still doesn't fall between 150 and 900 ohms, replace the pickup coil in the distributor, as explained below.

How are you doing? Still have to find the source of trouble? Okay, turn your attention to the connector pins of the electronic control unit to which the multiwire connector is attached. Find the pin coinciding with multiwire connector cavity No. 5. Hook up one lead of your ohmmeter to connecting pin 5 and the other lead to ground, as shown in the diagram for test No. 5. The ignition switch must be off.

The ohmmeter should not show a reading (0 ohms). If it does, remove the electronic control unit. Using a wire brush, clean the back of the unit and the mounting area. Reattach the unit, making sure bolts are tight. Do the test again.

Hope that a poor ground connection is causing the trouble. If it isn't, and the ohmmeter again records a reading, replace electronic control unit and dual ballast resistor.

Since the ballast resistor has the



Air gap between pickup coil and reluctor is adjusted by turning pickup-coil adjustment screw. Use a nonmagnetic feeler gauge. Reluctor, feeler gauge and coil should be in loose contact. The '78 and '80 models use .006-inch gauge. For others you need .008-inch gauge.

job of protecting the electronic control unit, the fact that the unit has failed may mean the ballast resistor has failed.

You must always replace the dual ballast resistor when replacing the electronic control unit.

Making distributor checks

Remove the ohmmeter and voltmeter and reconnect the multiwire connector to the electronic control unit. Remove the distributor cap, which is held by two retaining clips that you can snap loose with a screwdriver. Now place two screwdrivers under the rotor and lift it off the distributor shaft. Adjust the air gap between a reluctor tooth and the pickup coil in the following manner:

1. Engage the large nut of the crankshaft pulley with a wrench and turn the pulley clockwise until a reluctor tooth and the pickup-coil tooth line up.

2. Loosen the pickup-coil hold-down screw and insert a plastic (non-magnetic) feeler gauge between the reluctor tooth and pickup-coil tooth. The feeler gauge should be the size specified on the Vehicle Emission Control decal. In most cars, a 0.008-inch feeler gauge is required. However, for 1978 and 1980 models, use a 0.006-inch feeler gauge.

3. Move the pickup coil until the tooth of the pickup coil, feeler gauge and tooth of the reluctor come in contact. "Contact" means that all three touch, but you should be able to move the feeler gauge without having to use force. Tighten the pickup-coil hold-down screw.

4. Double-check the air gap by trying to insert, between the reluctor and pickup coil, a feeler gauge that is 0.002 in. larger than the one you used to make the adjustment—a 0.010-inch gauge for all models except 1978 and 1980, which require a 0.008-inch gauge. You should not be able to get this gauge between the two. If you can, you didn't make the adjustment properly. Do it again.

Note: Don't use force to insert the feeler gauge between the reluctor and pickup coil.

5. Disconnect the vacuum-advance hose from the engine and draw in on it with your mouth or a hand vacuum pump to create a vacuum. Watch the pickup coil and plate assembly. The assembly should rotate, but the pickup-coil tooth should not strike any reluctor teeth. If it does, the gap isn't set properly.

Incidentally, if the pickup coil and

You can remove the pickup coil without removing the entire distributor. Be careful not to lose the reluctor keeper pin.

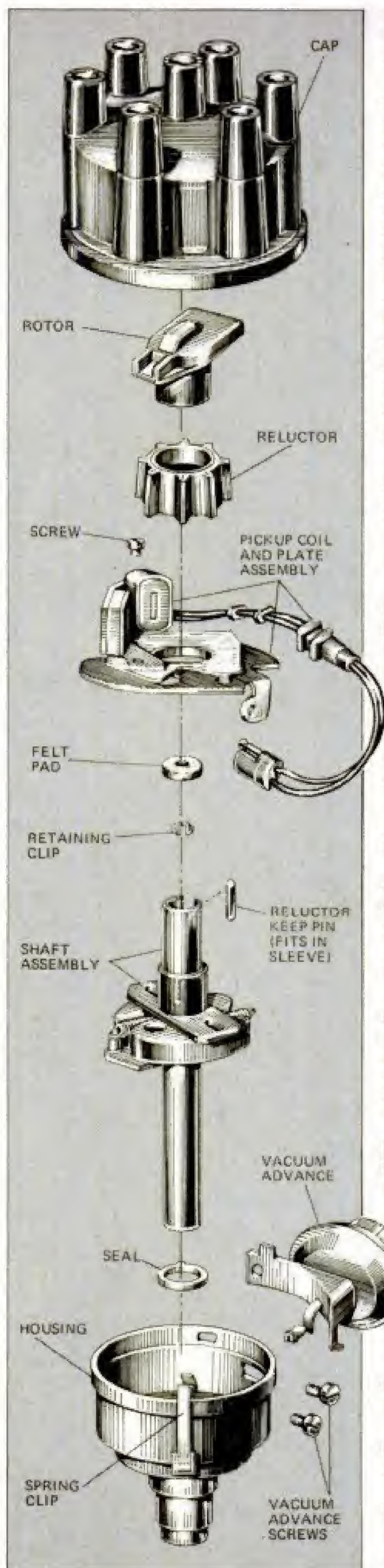


plate assembly do not rotate as vacuum is applied, the vacuum-advance unit is shot. Replace it.

If you haven't found the cause of trouble yet, make a spark-intensity test by detaching the high-tension cable from the center tower of the distributor. Holding the cable with insulated pliers so you don't get a shock, position the end of it 1/4 inch from a clean ground on the engine. Have someone crank the engine. If there is no spark, either the electronic control unit or ignition coil is bad. Strike a bargain with the dealer who sells you parts: Buy the ignition coil first and install it to determine if it's the cause of trouble. If the engine still won't start, return the coil for an electronic control unit.

This procedure can serve as a guide when replacing the pickup coil in a six- or eight-cylinder Chrysler Basic EI System distributor.

You don't have to remove the distributor from the car to do this.

1. With the distributor cap laid aside and the rotor out of the distributor, place two screwdrivers under the reluctor, one on each side. Lift the reluctor straight up and off the shaft. Retrieve the reluctor keeper pin.

Be careful. Don't let a screwdriver slip and strike a reluctor tooth, and don't let the reluctor hit against anything.

As long as the reluctor teeth are in good shape, you can reuse the part.

2. Remove the screws holding the vacuum-advance unit to the distributor housing. Disconnect the arm of the vacuum advance from the pickup coil and plate assembly. Remove the vacuum advance.

3. Remove screws and lock washers holding the pickup coil and plate assembly to the lower (shaft assembly) plate and depress the retainer clip to get the assembly out of the distributor.

4. Find the support pins for the pickup coil and plate assembly on the lower plate. Apply a drop of distributor-cam lubricant to each one of them.

5. Place the new pickup coil and plate assembly on the lower plate.

Lock the retainer clip, if there is one. Install and tighten lock washers and screws.

6. Install the vacuum-advance unit.

7. Position the reluctor keeper pin on the reluctor sleeve in the shaft and slide the reluctor firmly into place.

8. Set the air gap between the pickup coil and plate assembly, as previously described.

9. See if there's a small felt pad in the top of the reluctor sleeve. If so, apply one drop of light engine oil to it before installing the rotor. **PM**



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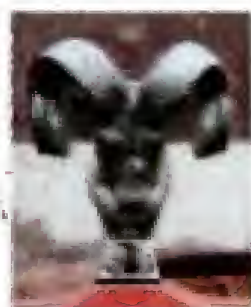


**New tailgate.
Easier operation.
More galvanized steel.**

**More galvanized steel in box.
Fights rust in critical areas.**

**Redesigned roof line,
aerodynamic side styling.
Reduce drag coefficient.**

**New parking and turning lights.
Relocated to avoid stones,
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even more strength, durability and efficiency.

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galvanized steel that provides critical area rust protection, maintaining our lead over Ford and Chevy

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We weld our pickup boxes to cross sill brackets. Ford and Chevy bolt theirs through the box. Brackets eliminate rust-prone bolt holes.

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More than Ford or Chevy.

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Satisfaction guaranteed or your money back. If you're not satisfied with your new 1981 Dodge truck, just bring it back in good condition with no metal damage within 30 days or 1,000 miles, whichever comes first. When the dealer gets clear title, you'll get your money back, excluding finance and insurance charges. Trade-in refund may differ from trade-in allowance on retail sales contract. Ask participating dealer for details.

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transmission. More than Ford or Chevy. Improved aerodynamic styling, reduced weight, and the dependable, efficient Slant Six engine all contribute to this Ram 150's superior gas mileage.

* **18** EPA EST MPG **22** EST HWY

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Dodge Trucks



DODGE TRUCKS ARE RAM TOUGH

With standard Slant Six engine, optional automatic transmission. Use EPA est. mpg number for comparison. Your mileage may vary depending on speed, distance and weather. Actual Hwy. mileage will probably be less. Calif. est. lower.

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QUESTIONS ANSWERED

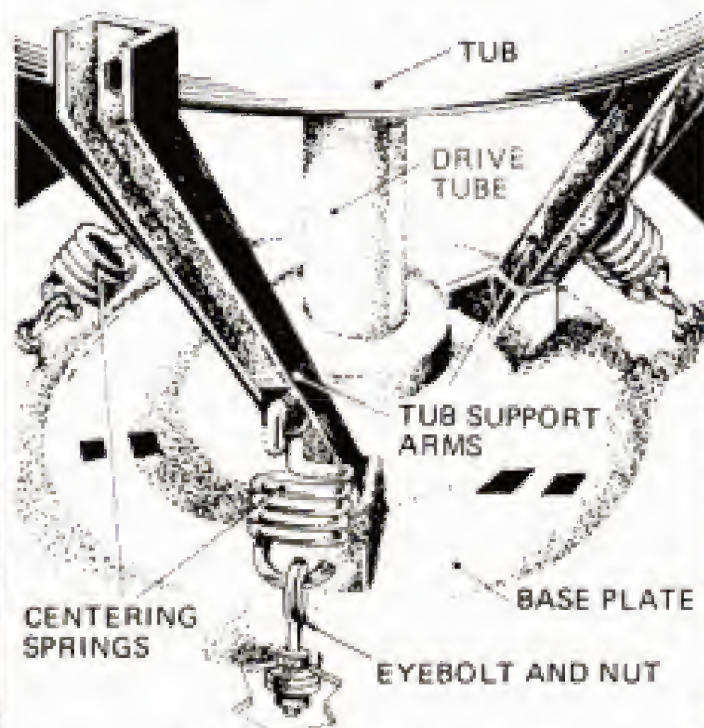
Leaning tub

My problem is with a Maytag automatic washer, model No. A-502. The tub leans to one side and doesn't rotate. I don't know how to disassemble it or exactly what the problem is. Do you think it's repairable?—Fred E. Hood, Valles Mines, Mo.

Seems to us that the problem is with one of the tub's centering springs. To determine whether it is, you'll have to first pull the plug from the electrical outlet. Next, remove the back panel from the machine.

You will see a large tub supported by three arms. On each of these arms is a centering spring that holds the arm to the base of the machine with eyebolts. You will probably find a broken spring or eyebolt. These parts are available from Maytag. The part number of the spring is 2-11953; it costs about \$1.10. The eyebolt part number is 2-11944; the nut is No. 2-11949. They sell individually for 25 cents each.

Before removing the broken



A broken eyebolt or centering spring can cause your washing-machine tub to lean.

spring, note how far the eyebolt is turned into the nut. This can be gauged by the number of threads above the nut. Next, replace the centering spring by hooking the new spring into the bracket on the tub support arm. Start the eyebolt into the nut, tilt the tub toward the spring and hook the spring into the eyebolt. Tighten the nut on the eyebolt to the original position.

Level the machine by adjusting the leveling legs under the machine. When the tub is centered, check under the base plate to make sure the motor-to-pump and motor-to-trans-

mission belts are both on their pulley.

Replace the rear panel and connect the machine back to the electrical outlet.

Put a normal load of clothes in the machine, fill it with water and start the agitation. After five or 10 minutes, stop the machine and check the tub. It should be centered in the opening of the cabinet top. If the tub is leaning, tighten the proper spring-adjustment nuts. Restart the agitation action and again check the tub centering for any needed secondary adjustments.

Traditional versus solid-state

While shopping for a new washer and dryer, we discovered the Sears solid-state electronic models. I understand they have been out only about two years.

Could you please tell me the advantages and disadvantages of these new solid-state machines versus the traditional ones?—Scott C. Houle, Portsmouth, N.H.

The solid-state washer and dryer were successfully field-tested before they were released on the market. Their major difference from the traditional machines lies strictly in the components that make up the control panel.

Instead of using 120 v. and three or four individual parts to control machine functions, they now use 20 v.a.c. and about 20 v.d.c. combined with printed circuits to control the same functions. The washer uses a transformer that reduces the 120-v. line voltage to about 20 v.a.c.

An electronic control board, which is operated by about 20 v.d.c. through a relay, controls timing, motor speeds and water temperature. Finally, an electronic cycle selector (touch buttons) replaces the manual timer knob.

This solid-state reliability eliminates mechanical wear, electrical arcing, sticking contacts and other problems familiar to the parts behind the traditional control panel. One of the few disadvantages to the solid-state washer and dryer versus the traditional model is its higher price.

Perpetual dryer

Please help! Our Sears Kenmore dryer No. 110.7357620 will not shut off automatically. We have tried everything but still can't find the trou-

ble. Could the timer be the problem? If so, which one, as the parts book lists two: a 60-hertz and a 50-hertz?—Mrs. George Warnowski, Roselle, Ill.

Welcome to planned obsolescence! The timer, as you suspect, is the problem. First, you want the 60-hertz item (50 hertz is for overseas use). Your timer is actually a little motor with anywhere from 12 to 20 contacts on a rotary wheel. The contacts do, in time, wear and pit—making for poor contact. You can, if you are patient, clean them with an emery board. However, you lose the hard original surface and they will pit again faster. The situation is much like the points in your car—if you have ever fooled around half a Saturday morning trying to salvage a 75-cent set of points from the family bus, you'll know what I mean. Toss your timer and get a new one: We think that this solution will do the trick and let your dryer get some rest.

Close fit

I'm having trouble replacing the door gasket on my Hotpoint double-oven, model No. 20RJ 83D, serial No. WW0011010. As there isn't enough clearance behind the lip of the oven liner to install the gasket, it seems that either the liner must slide out or the lip must be pried down to allow installation. How do you suggest I make the fix?—Paul Kohler, New Canaan, Conn.

You're right in assuming that the liner comes out. You have a spring-loaded oven liner. Springs on both sides of the liner hold it into the oven cavity. To replace the gasket, you must slide the liner out about ¼-in.

Hotpoint uses a special tool to accomplish this. You can use a putty knife and a flat-bladed screwdriver. Slip the putty knife in behind the screwdriver. Twist the screwdriver. This will lift out the liner enough to work out the old gasket. Work the new one in behind the lip. Once the new gasket is in place and you remove the putty knife and screwdriver, the liner will spring back into place.

PM

If you have a question about any appliance, send it to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.

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PM LOOKS AT PROFESSIONAL QUALITY POWER WASHER

Water and air valves (inset) permit metering the flow to control the mixture on the Thunder Gun.



If your house boasts good water pressure, and you own a 1-hp or bigger compressor, this rig lets you do cleaning chores around home and yard quickly and with professional-looking results.



Tool provides a good way to rid auto body of winter road chemicals (which are biggest cause of body rot). High-velocity stream makes quick work of degreasing.

The Thunder Gun power washer is a new concept in high-powered cleaning for homeowners—and a handy accessory for an air compressor. Designed for use with cold or hot water, it will deliver detergents, fertilizers, pesticides and other liquids to any surface at high velocity. Intended for use with a 1-hp (or greater) air compressor, it is capable of a maximum nozzle discharge velocity of 300 mph, as indicated in the data chart below.

Operation is simple: Connect the air and garden hoses to their respective fittings and run the flexible plastic tube into a container of the desired additive. Open the air and water valves and aim.

Model TG 1000 comes with 50 ft. of chemical-resistant tubing and 4 oz. each of general-purpose detergent, industrial-strength detergent and degreaser. Available from J.C. Penney, Montgomery Ward and J.C. Whitney. Thunder Gun is less than \$100. Briar Industries Inc., Box 55, Gardner, Kan. 66030, makes it.—Harry Wicks

Air Pressure (P.S.I.)	Airflow (C.F.M.)	Water Flow (G.P.M.)	Velocity From Nozzle—Air And Water (MPH)
50	4.1	3.7	153
60	4.95	3.4	180
70	5.50	3.4	199
75	5.90	3.4	212
80	6.25	3.4	224
90	6.95	3.4	247
100	7.50	3.3	265
115	8.60	3.1	300

PHOTO HINTS

Life extender



You can extend the tray life of your darkroom chemicals from one working day to about three by floating plastic wrap on the liquids' surface. Be careful to avoid air bubbles and to cover the entire surface of the trays.

—C. Boyd Pfeiffer

Strip-clip tip



Photo-paper test strips, loose in a box of full-size sheets, are not only difficult to find, but often hinder rapid access to the full-size paper. A large paper clip taped to the inside of the box lid will store the strips neatly.

—Ken Patterson

Attractive proposition

Static electricity can help remove dust from SLR mirrors and other camera interior areas. Charge a hard piece of nylon or a comb by rubbing it with wool, and run it closely across the mirror surface. Most, if not all, the dust should be picked up.

—Bernard M. Shomstein

Bag it

Carry one or two lock-top plastic bags with your camera. When you need a place to rest the camera for a long exposure or a self-timer shot, fill the bag with sand, soil or other loose material. This can be molded to steady camera on most surfaces. —Wayne Fugate



“I HAVE NO IDEA WHAT EVERYONE ELSE IS DRINKING THESE DAYS.”

Sure, in school I drank beer. Because everyone else drank beer. Crushing the cans was real important, too. And then there was what I call my “wine phase.” You know, wine with everything. And everyone.

The funny thing is, there are still people out there who order what everyone else orders. That's fine with me... but I'll have an I.W. Harper. Because the only “smart” thing to order is what you like.

So, like I said, I have no idea what everyone's drinking these days. Except me and a few friends.



I.W. HARPER.
WHEN YOU KNOW WHAT YOU LIKE.

86 proof Kentucky Straight Bourbon Whiskey. © 1980, I.W. Harper Distilling Company, Louisville, Kentucky.

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Photograph by [unreadable]

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**JUST TWIST
REGULATOR
TO SELECT
FULL IN-
VIGORATING
FLOW OR
GENTLE
SPRAY.**

State _____ Zip _____

FROZEN STIFF?



It's 10° outside . . . Even getting colder. So you bundle up in layers and layers of heavy clothes. First with long underwear . . . then bulky, restrictive thermalwear on top.

Oh, you were warm all right. Like in a Turkish bath. Because you began to perspire from all your activity. And perspiring in that mountain of clothes is like perspiring in a plastic bag! The perspiration is locked in. So there you are. Wet and miserable.

But now, at last, Damart has solved the problem. Because Damart invented underwear that keeps you *warm, dry and comfortable* no matter how cold it is or how long you stay out. Underwear that's soft and light so you can move easily. Underwear knitted to let the *perspiration evaporate through* so you always stay warm and dry next to your skin.

Damart does this with a new miracle fabric—Thermolactyl. No other underwear does this! You can wear Damart indoors too, and turn your thermostat into the 60's. You'll feel perfectly comfortable and enjoy dramatic savings in home heating costs.

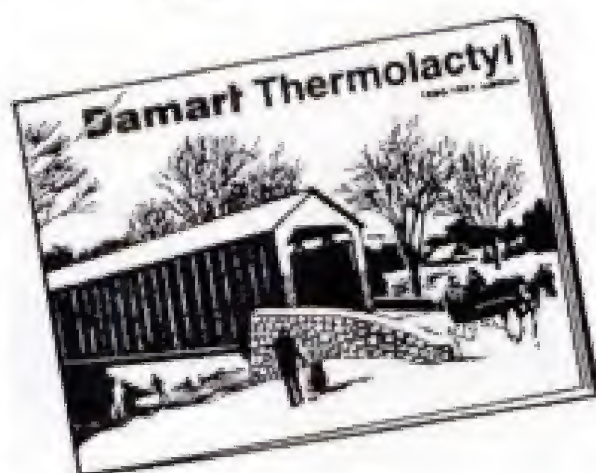
Damart is so comfortable that the Mt. Everest climbing expedition wears it. So does the Chicago Bears Football Club, New England Patriots and Philadelphia Eagles.

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Dodge Aries-K is the first automobile to deliver both 6-passenger room and gas mileage ratings of **[25]** EPA est. mpg./41 est. Hwy.* A combination that no other car can match. How did Chrysler do it? With advanced front-wheel-drive technology. Solidly based on over 11 billion estimated miles of owner experience with Chrysler Corporation's highly successful small cars,

including Dodge Omni, Dodge 024 and Colt. More small-car front-wheel-drive experience in America than Datsun, Toyota, GM or Ford.

With all that experience, Chrysler engineers designed Aries-K as a total system—a *Direct Power System* of front-wheel-drive that puts the weight of the engine

and transaxle directly over the front driving wheels. This gives you excellent traction in rain and snow. The car is *pulled* through turns, rather than pushed. So you get sure control and maneuverability. And with the engine, transaxle and entire power-train in front of the passenger compartment, Aries-K offers mid-size room—6-passenger room—in a neat, efficient package. And without a transmission, drive shaft and rear-axle differential churning away underneath the Aries-K, you'll enjoy a smooth, quiet ride. And an efficient use of energy.

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America's only front-wheel-dri

The Aries-K Direct Power System:

The heart of Aries-K is the new Chrysler 2.2 litre Trans-4 engine designed specifically for front-wheel-drive. It's part of a Direct Power System that puts the engine directly over the front driving wheels of the car and allows power to flow directly to them.

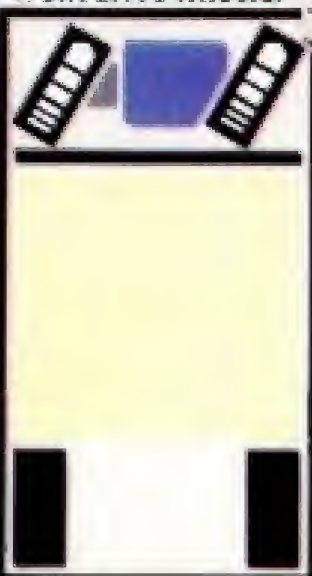


America's only front-wheel-drive 6-passenger wagon rated **[24]** EPA est mpg, 40 est Hwy.*

Rear-drive cars transmit engine power thru drive shaft & rear-axle differential.



In Dodge Aries-K Trans-4 engine power flows directly to the front drive wheels.



Trans-4: the engine with an electronic control computer.

The Trans-4 is an engine with an electronic control computer, a sophisticated feed-back system. Chrysler's exclusive Electronic Fuel Control System that includes electronic ignition, electronic control of spark timing and electronic feedback carburetor; seven sensors located throughout the engine monitor functions and feed data to an on-board computer which continuously adjusts the timing and air/fuel ratio for optimum efficiency.



*Use est mpg for comparison. Your mileage may vary depending on speed, weather and trip lengths. Actual highway mileage will probably be less. Calif. est lower. Buy or lease at your Dodge dealer.

High mileage. And room for 6. There are other cars on the road today that have mileage ratings as high as Aries-K. But none of them have the 6-passenger room Aries-K delivers. The reason: Chrysler front-wheel-drive.

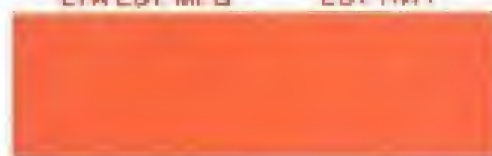
Keeping the power train completely forward of the passenger compartment has a number of benefits. All of them make more room for people. Without a huge transmission hump, Aries-K has plenty of front leg room. Without the clumsy drive-shaft hump that runs the length of

rear-drive cars, middle seat passengers in the new Aries-K don't have to sit with their knees tucked up under their chins.

In fact, the entire passenger compart-



25 / 41
EPA EST MPG EST HWY*



ment has been designed for lots of head room, shoulder room and hip room.

"Service-Engineered" Aries-K. Simple to service. Designed inexpensive to maintain.

Aries-K was designed to make servicing as simple as possible. Many components that require scheduled maintenance are up front and easy to reach.

6-passengers

ment has been designed for lots of

We eliminated many service operations other cars still require. Aries-K performs them automatically. And scheduled maintenance intervals have been extended.

ve 6-passenger car rated **25 41.**

EPA EST MPG EST HWY*

Aries-K engines are handled with such care, that even a white glove inspection isn't permitted for fear of leaving lint on any part.

Our engineering goal was to build the highest quality car in its class in America. To help achieve that goal, Chrysler set

up one of the most technologically advanced plants in the world with the most sophisticated assembly techniques. It's why Aries-K is backed up with a guarantee:

Satisfaction guaranteed or your money back.

If you're not satisfied with your

new Dodge Aries-K, purchased for personal use from a participating dealer, bring it back in good condition and with no metal damage within 30 days or 1000 miles, whichever comes first. When the dealer gets clear title, you'll get your money back, excluding finance and insurance charges. Trade-in refund may differ from trade-in allowance on retail sales contract. Ask participating dealer for details.

With Aries-K pulling for you, America's not going to be pushed around anymore.



AMERICA'S NOT GOING TO BE PUSHED AROUND ANYMORE.

DETROIT LISTENING POST

GM reveals plans for 1980s

In a surprise move, General Motors has given an unusually revealing sneak preview of some of the cars and engines it will be introducing later in this decade. Among them are a handsome clay model of the proposed 1984 electric car; a pair of working prototype two-seat commuter cars (see *Detroit Listening Post*, page 12, Oct. '80); a family of experimental engines (three-, four-,



GM's electric car, shown in clay, is slated for full production by the 1984 model year.



The new family of GM automobile engines includes a Three, a Four, a Five and a Six.

five- and six-cylinder) using interchangeable parts; and, perhaps most surprising, a compact, 115-hp turbine engine installed in the 1979 Cadillac Eldorado.

GM president Pete Estes says the electric is "on" for the '84 model year. "I don't know whether we'll make it or not," he admits, "but that's our goal today."

GM's zinc-nickel-oxide battery (announced as a "breakthrough" last year) remains the prime candidate to power the car, but a Gulf & Western-developed zinc-chloride power system is also being tested and considered.

The two front-wheel drive prototype commuters are a bit ungainly in looks, but surprisingly well appointed and comfortable inside. One was powered by a 1.5-liter, three-cylinder engine with a five-speed manual transaxle and the other by a 1.9-liter V4 with automatic. The latter was pleasant to drive, the former slow and shaky, but acceptable.

By the time they hit the showrooms, these cars will probably be better looking and have even better city fuel economy than the 42 and 30 mpg estimated for the two early attempts at the theme.

As for the engine family, visualize a 3.0-liter V6—basically a bored-out version of the 2.8-liter, 60° unit currently optional in GM's fwd X-cars. Knock off one end cylinder and you have a V5—another and it's a V4. Or slice it in half lengthwise and— presto—it's an in-line Three. Make two different heads (one for two cylinders and one for three) and you have all four variations covered.

Crankshafts, camshafts and intake manifolds are specific to each, but most other internal parts are common and interchangeable. Each cylinder is 0.5 liters, giving a useful range of from 1.5 to 3.0 liters. A computerized antiknock system (already in GM turbo engines) will be used to allow a compression ratio as high as 9.8 to 1 for maximum efficiency. Roller lifters (like those in the '81 5.7-liter diesels) will also be used for minimum friction.

Balance problems? None that can't be effectively dealt with, say the engineers.

Estes states that 60 percent of the engines in domestic GM cars will be four-cylinders by 1985, 20 percent will be Sixes, and nearly 20 percent diesels—leaving little or no room for the once-dominant V8.

The turbine engines, called AGT-5, is considerably smaller than its GM research predecessor, yet still twice as big as what is needed for future automotive use. It has low emissions, plus performance and fuel economy comparable to a current small V8, but weighs much less and can burn almost any flammable fuel. You won't be able to buy one much before the end of this decade, if, indeed, it sees production at all.

Future Chrysler models

Folks at the "new" Chrysler Corp. want to make sure that you and I know they have a lot more coming after their much-publicized K-cars. So they're being unusually candid, and even showing off some future models and prototypes now and then. Latest revelations (for '82) include a sporty fwd minitruck based on the Omni/Horizon sport coupe and looking a bit like a scaled-down Chevy El Camino or Ford Ranchero;

a plush Chrysler version of the K-car, possibly featuring an optional V6 engine and later a French Peugeot turbodiesel Four; and a Camaro/Firebird-type 2+2 sporty coupe on the K-car platform, powered by a turbocharged four-cylinder gas engine. What these vehicles look like, Chrysler is keeping under its hat.

A year later comes a new "Pantera" sports car, to be built (like the original Ford Pantera) by DeTomaso of Italy, plus an all-new series of Plymouth/Dodge/Chrysler mid-size entries.

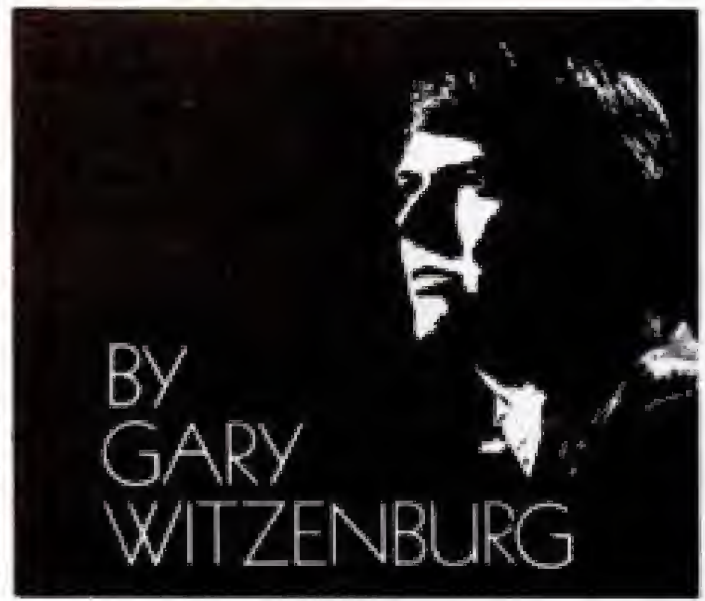
Chrysler's largest cars by then, these will share a stretched K-car fwd platform with some new minivans and light trucks to be introduced soon after.

Ford's big cars not dead yet

Preliminary planning is well underway for next-generation Ford full-size, five-passenger cars, but the corporate go-ahead has not yet been given. Ford doesn't want to leave this fast-shrinking (but still profitable) market to GM, but the final decision and allocation of the necessary money depend strongly on what happens in the next few months. Even if approval comes soon, Ford's new fwd family and luxury cars could not be brought to market before the '84 model year.

Jeep CJ pickup coming

American Motors has confidentially shown its Jeep dealers a new CJ-7-based light pickup—and they loved it. Starting early next year, this will give them something with which to compete against the Japanese 4wd cars and gas-stingy standard-size 4wd pickups. With a 2.5-liter, four-cylinder engine likely as standard equipment, it should be competitive in fuel efficiency with the Japanese trucks. **PM**



FORD ANNOUNCES THE 21 MPG PICKUP



**Now...great gas mileage
in a full-size truck!**

Now in tough '81 Fords: the highest estimated MPG rating ever achieved by a 6-cylinder Ford Pickup. Delivered by Ford's husky 300 Six...available in F-100/F-150 models that take payloads up to 2,530 lbs.!

21

EPA
EST.
MPG*

29

EST.
HWY.*

F-100/F-150 with 4.9L (300 CID) Six and 4-speed overdrive option.
EPA EST. MPG with std. 3-speed:
20 MPG, 27 estimated HWY.

Tough new Fords... higher ratings for 1981.



New compact rating

Even high-economy Ford Courier has improved highway mileage for '81.

27

EPA
EST.
MPG*† **39** EST.
HWY.*†



New Bronco rating

Bronco with husky 4.9L (300 CID) Six shows 20% improvement in EPA est. MPG over last year.

18

EPA
EST.
MPG*† **24** EST.
HWY.*†



New van mileage

Ford's business van offers even better estimated MPG for '81. 4.9L (300 CID) Six std.

19

EPA
EST.
MPG*† **26** EST.
HWY.*†



New V-8 mileage

New truck 4.2L (255 CID) V-8 gives record-high estimated MPG for V-8 Ford Pickups.

17

EPA
EST.
MPG*† **26** EST.
HWY.*†



New 4 x 4 mileage

Now...20% boost over last year in estimated MPG fuel economy for tough Ford 4WD Pickups.

18

EPA
EST.
MPG*† **24** EST.
HWY.*†

More about mileage

*Use for comparison. Your mileage may differ depending on speed, distance and weather. Actual highway mileage will probably be less than estimated. California estimates lower. All comparisons are to 1980 Ford vehicles. See your dealer for the 1981 EPA Gas Mileage Guide.
†With optional manual overdrive transmission.

**Plus the first and only
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Another Ford breakthrough! New automatic transmission shifts into overdrive at about 45 mph... automatically. Engine speed drops, truck speed stays same. Available with 5.0L V-8 engine.



FORD

FORD DIVISION



HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Electrical inquiry

When we moved into a 15-year-old house recently, we found that almost every electrical outlet was so loose that plugs would actually drop out and not make contact. Since our electrical consumption seems high, I was wondering if the two could be related. When I replaced all of the duplex outlets and most of the switches, I found that I do not have aluminum wiring.

Is there any gauge or other equipment that I can use to determine whether I have a problem? I'm not very knowledgeable about wiring. However, my breakers haven't kicked off. So I don't think I have an overloaded-circuit problem.—R.R. Wal-lin, Springfield, Ill.

For a guy who isn't very knowledgeable about wiring, you've already gone above and beyond the homeowner's call of duty by replacing all the receptacles. Your original condition not only may have run up your bill, but it may have been a potential fire hazard.

At this stage, I can only suggest the services of a licensed electrician to check out your system. The \$100 to \$200 he may charge is very inexpensive for peace of mind and a safe house.

Fuzzy fiberglass fibers

My white, translucent, corrugated fiberglass panel has lost its surface, exposing some of the fibers. How can I reseal the surface?—Joseph Carney, Mission, Tex.

The trade uses the term "blooming" for panels that are beyond the stage of repair. If the fibers are merely exposed, and not sitting up as if they're growing, you can coat them with liquid polyester resin, available at Sears for about \$11 per quart. However, you may get no more than three to four extra years of service. You may be better off replacing the panels.

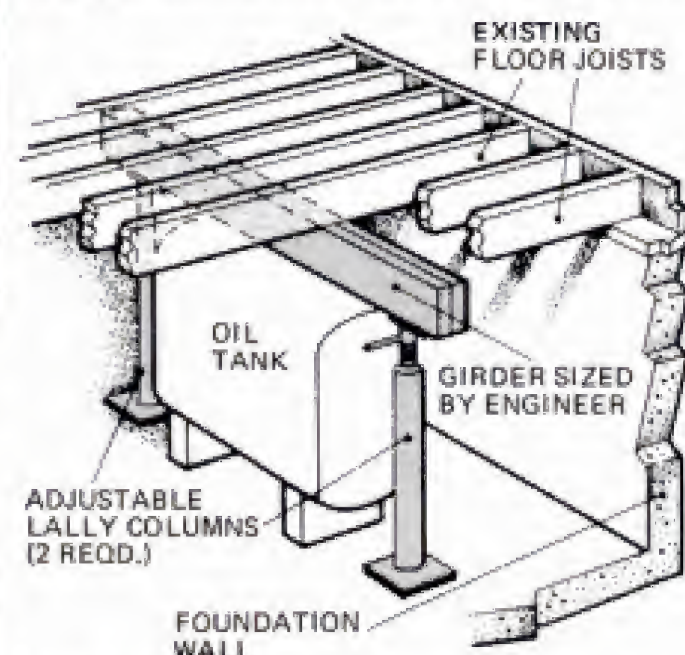
Floor support

I intend to install a wood stove on my outside wall. The stove weighs 350 lbs. So I want to support the floor for this extra load. The only catch is that there's an oil tank in the basement, directly under the spot where I intend to put the stove. Any ideas for supporting the floor system?—Arthur B. Hirshorn Jr., Gloucester City, N.J.

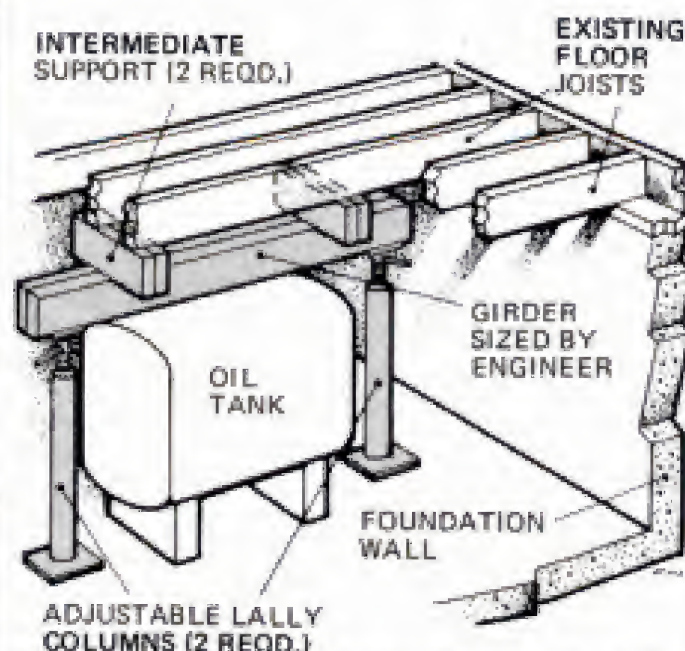
A 350-lb. load distributed over the

area of a stove would not normally warrant extra support. A piece of $\frac{3}{4}$ -in. plywood between the floor and the fireproof material under the stove will distribute the load.

However, to be on the safe side, the simplest method of supporting the floor is to add a girder under the floor joists (see drawing, below). You can do this if the floor joists are perpendicular to the length of the tank. The girder could be supported by col-



If joists are perpendicular to oil tank, support them with girder and Lally columns.



When joists are parallel to the length of the oil tank, install intermediate supports spanning at least two joists.

umns on either side of the oil tank. If the floor joists are parallel to the length of the tank, you will need to add intermediate supports to spread the load more evenly over several of the joists.

I've only shown the principle. You should take these drawings to a licensed engineer for proper sizing and spacing of all members. He'll need more information, too, including the weight of the fireproof material under the stove. For more information on proper stove installation,

see *How to Keep the Home Fires Burning . . . Safely*, page 74, Oct. '80.

Walls come crumbling down

The stone walls of the basement where I teach ceramic classes are posing an annoying problem and potential danger. The mortar keeps falling from the joints. What can I do to retain it?—Lucille E. Rohler, Brookston, Ind.

Your solution lies in regrouting the stone walls. This involves scraping out some of the existing mortar and repointing with new mortar. The depth of scraping depends on the size of the stones, but the more mortar you can remove without causing the stone to loosen, the stronger the wall will be.

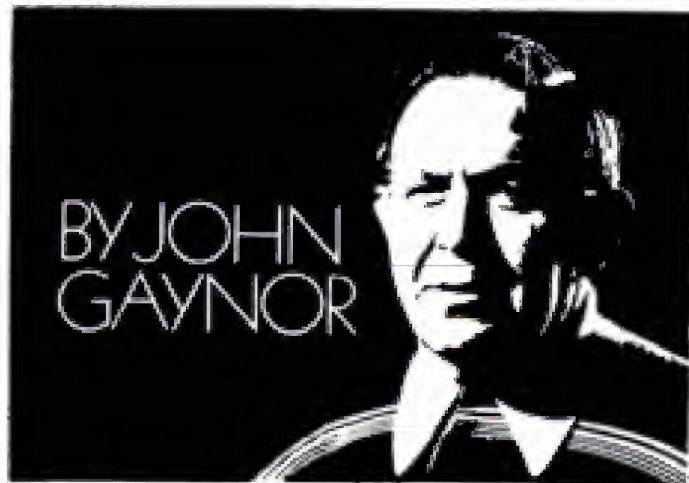
I suggest that you purchase the small-size bags of mortar mix. Although you'll be paying a premium price for sand, the convenience of carrying sand and cement downstairs in one bag is well worth the extra cost.

Thoroughly remix the dry mix in a wheelbarrow or mortar pan; then add water. Add only enough water to make the mix pliable. Too much water or water pressure while mixing will wash the cement coating off the tiny granules of sand and weaken their bond.

Brush a little water on the stones and joints with a whitewash brush. Then push the mortar into the joints with a small pointing trowel. Finish off by pressing with a length of dowel to give the joints a finished look. Wear heavy rubber gloves and goggles when you work with cement products.

PM

Do you have a home maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in this column. For more home repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send order(s) to PM, Dept. HCG, Box 1014, New York, N.Y. 10019.



BY JOHN GAVNOR



**What's the extra
in Calvert Extra?**

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A painstaking process that
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part of the whiskey. Taste
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Whiskey. You'll agree our
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NTS's Master Course in Microcomputers includes the NTS/HEATH H-89 Microcomputer (#1 above). It features floppy disk storage, "smart" video terminal, two Z80 microprocessors, 16K RAM memory expandable to 48K. HDOS included.

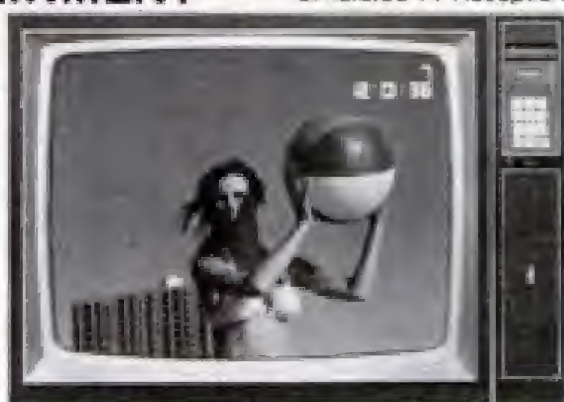
The NTS/Rockwell AIM 65 Microcomputer (#2) is included in our Microprocessor Technology Course. It's a single board unit featuring an on-board 20 column alphanumeric printer with 20 character display. This 6502-based unit also has 4K RAM memory, expandable, 8K monitor ROM and 8K advanced BASIC interpreter on ROM.

And in NTS's Master Course in Electronics and Industrial Technology, you'll work with the NTS/KIM-1 Microcomputer (#3). This unit features a 6 digit LED display with an on-board 24 key hexadecimal calculator-type keyboard. It's a 6502-based microcomputer with 1K of RAM memory, expandable.



HOME ENTERTAINMENT ELECTRONICS

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And because we're NTS, we include an array of state-of-the-art test equipment—including digital multimeter—with most of these programs.



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Classic milk-drop splash was captured with an SLR camera and ordinary automatic flash.

Stop the action with high-speed photography

You can use your automatic flash to
freeze the fastest subjects.

by Armand Ensanian

Remember Harold Edgerton's classic milk-drop photographs? When he first developed high-speed photography, Edgerton needed a raft of complex, expensive equipment to take the pictures that made him famous.

Today, anyone with a camera and a \$30 automatic flash unit can take similar high-speed photos, although there's not much chance of becoming famous as a result.

An SLR or 2 $\frac{1}{4}$ camera will make picture taking easiest, but any camera (instant, rangefinder, 110) will work, as long as it has a provision for holding the shutter open for a few seconds; this usually means it has a "B" setting. Some auto-exposure cameras will stay open long enough if fired in total darkness. Also, the normal lens of the camera should be able to focus at least as close as 3 $\frac{1}{2}$ feet; you've got to be able to bring the camera near the subject to fill the frame. A telephoto lens will help, but you'll lose depth of field.

The flash can be any automatic unit; more expensive models have

shorter flash durations. Some models that cost less than \$100 have durations as short as 1/50,000 second. A manual flash is no good because flash duration is fixed and too long.

The setup

Numerous subjects lend themselves to high-speed photography. Some obvious candidates like bullets bursting balloons are too hazardous, but the famous milk splash, with its beautiful crown, poses no danger. It can be photographed two ways.

The first requires quick reflexes. Pour enough milk into a plastic dish to completely cover the bottom. Secure a milk-filled eye dropper about 16 inches above the center of the dish and focus the camera on the point where a drop will splash. The flash should be at its minimum working distance from the splash (consult your manual).

In subdued light, hold the shutter open, release a drop and trigger the flash just as the drop hits the milk.



Quick reflexes caught drop before splash (see text). Note surprising spherical shape.



After the splash, the beads of the crown are shown briefly suspended in mid-air.



Beads plunge back after the splash. Photos were taken by varying tension on "switch."

The flash can be fired by its own test button, or by a switch connected to an adapter with a PC connector at one end and a female household plug on the other (widely available in photo stores). One of the best switches to use is a cheap Morse Code key; it permits quick firing. This method is particularly useful for capturing the drop just before it splashes (see photo above).

A nearly foolproof method is more complex, but still easy to construct. Tape a strip of aluminum foil inside a shallow plastic dish. Then tape a similar strip to a 1 \times 1-foot piece of plastic food wrap. Stretch the wrap over the lid so that the strips face one another and almost touch. Then tape the edges to the table. A smaller plastic lid with a 1-inch hole cut in the center should rest on the plastic wrap; add milk as before.

Attach wires to the foil strips and connect them to the flash trigger (preferably with the PC/household plug adapter). The gap between the foil strips should be about the thick-

(Please turn to page 64)



**only
3 mg tar**

TRIUMPH[®] BEATS MERIT!

**Triumph, at less than half the tar,
preferred over Merit.**

When tar levels were revealed, more smokers independently chose Triumph over Merit in rating overall product preference. Of those expressing a preference, over 55% preferred 3 mg Triumph to 8 mg Merit.

Results showed that Triumph was also preferred over 14 mg Winston Lights, 12 mg Marlboro Lights and other low tars.

Now, test for yourself. Compare Triumph with any other so-called "light" cigarette. You'll taste why we named it Triumph. Also available in Menthol.

National Smoker Study results available free on request.

Write: National Smoker Study, P.O. Box 2733, Hillside, New Jersey 07205

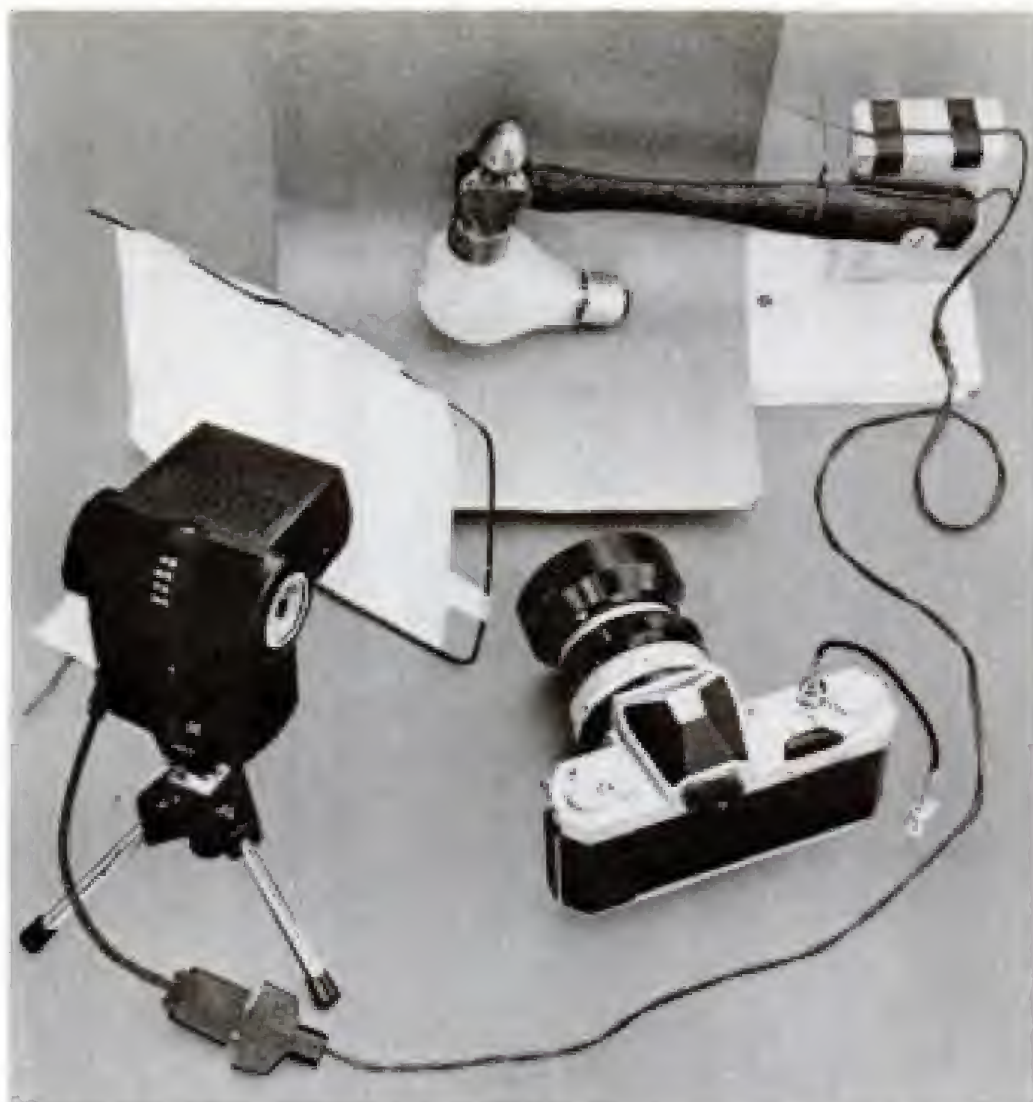


**Taste the UMPH! in Triumph
at only 3 mg tar.**

**Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.**

©Lorillard, U.S.A., 1980

3 mg. "tar," 0.4 mg. nicotine av. per cigarette, FTC Report Jan. 1980.



Setup for the breaking bulb: Note trigger wires, tracing-paper support, PC cord adapter. Camera should be a few feet away.

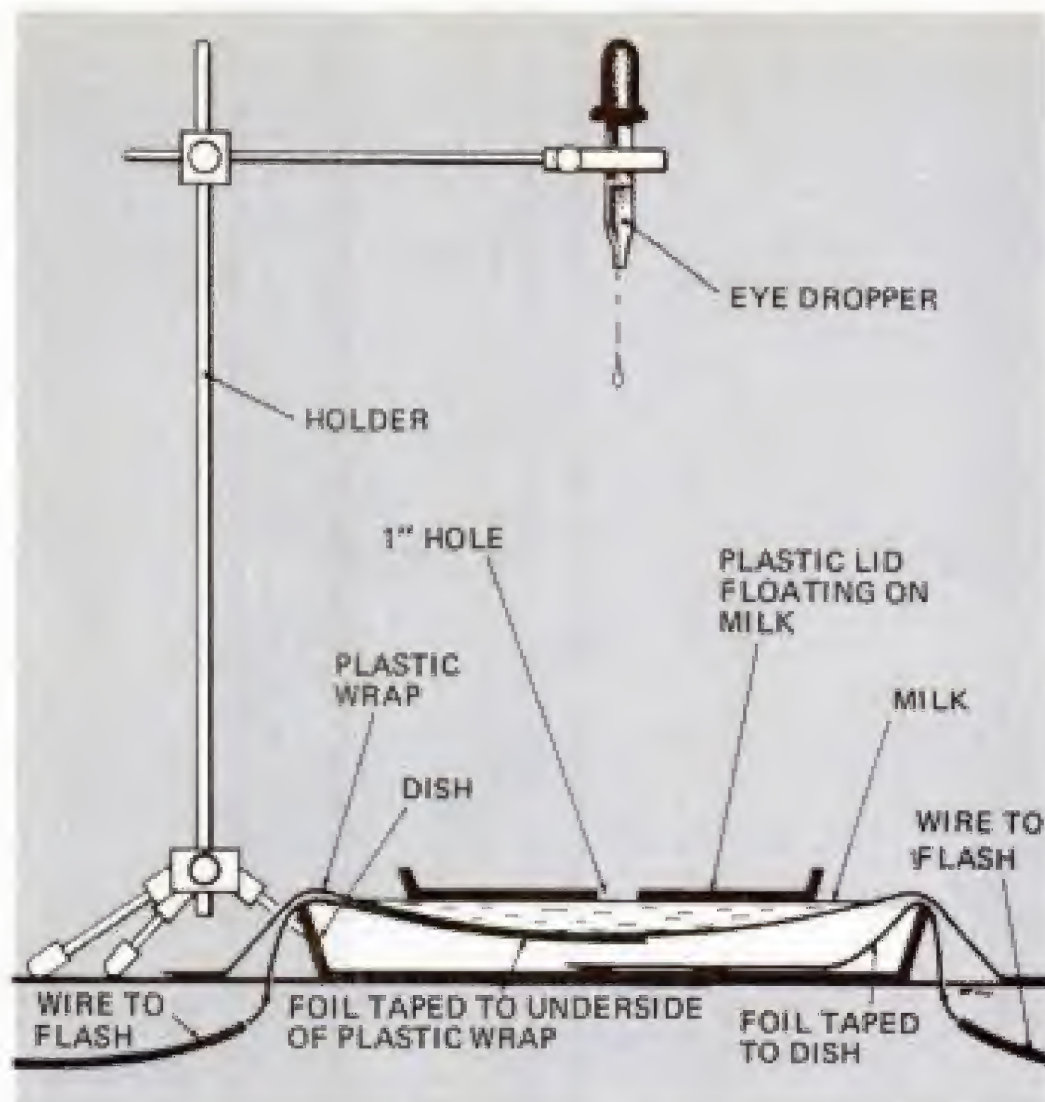


Illustration shows cross section of milk-drop arrangement. Dimensions have been exaggerated somewhat for clarity (see text).



No sense taking this photo until you've got a dead bulb. By varying trigger gap, different stages of breakage can be caught.



Common household items comprise apparatus (shown without milk or floating lid). Wires plug into PC-to-wall-plug adapter.

HIGH-SPEED PHOTOGRAPHY

(Continued from page 62)

ness of a sheet of paper. Test it by blowing on the milk; the flash should fire. The force of the drop hitting the milk should close the foil switch and fire the flash. To capture different stages of the splash's formation, adjust the tension of the plastic wrap by placing small weights on it outside the rim of the dish. More weight will pull the strips farther apart and postpone the flash firing.

With both methods, it is necessary to keep flash duration to a minimum. To do this, use coat-hanger wire to fashion a stiff support for a piece of 8×10 tracing paper (or wax paper). Position this paper about 6 to 8 inches in front of the flash unit. The paper reflects enough light back to the auto sensor to keep flash duration short, but passes enough

light to illuminate the subject. The paper also diffuses light and reduces harsh shadows.

Because the flash is the sole light source and the shutter must be open a fairly long time, it's important to work in light that's as dim as possible—perhaps even under a safelight (be careful with a safelight when

shooting color film). The shooting sequence goes like this: Focus the camera, cock it, set the flash trigger, charge the flash, douse the lights, open the shutter, fire the flash, close the shutter.

The ultrashort flash duration will lower the effective speed of the film, because most films are designed for shutter speeds between 1 and 1/1000 second. This phenomenon, known as reciprocity failure, must be adjusted for by increasing exposure about one stop.

Further exposure adjustment must be made for light loss caused by the tracing-paper reflector; an extra ½-stop increase should do the trick. Therefore, if the flash's exposure dial calls for f/11, the aperture should be set between f/5.6 and f/8. Shoot a roll of film of a stationary subject (no milk drops, just the set-

(Please turn to page 66)



Trigger is made from string and plastic spoons. Pull spacer and foil strips touch.



TRIUMPH[®] beats Salem Lights!

Triumph Menthol, at less than one-third the tar, preferred over Salem Lights.

When tar levels were revealed, more Menthol smokers independently chose Triumph Menthol over Salem Lights in rating overall product preference. Of those expressing a preference, over 61% preferred 3 mg Triumph Menthol to 11 mg Salem Lights.

Results showed that Triumph Menthol was also preferred by Menthol smokers over 16 mg Kool, 16 mg Salem and 8 mg Merit Menthol.

Now, test for yourself. Compare Triumph Menthol with any so-called "low tar" Menthol cigarette. You'll taste why we named it Triumph.

National Smoker Study results available free on request.

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**Taste the UMPH! in Triumph
at only 3 mg tar.**

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

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3 mg. "tar," 0.4 mg. nicotine av. per cigarette by FTC Method.

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Build your own air compressor from PM's plans



Once you have an air compressor in your home shop, you'll wonder how you ever got along without it. You can spray paint with it. You can inflate swimming gear, toys, auto and garden tractor tires. More important, you can sandblast parts and rivets in metal seams. You can blow-clean fine mechanisms and, with PM's unit, you can vacuum pump your car's airconditioning system prior to adding Freon—something you can't do with most ordinary air compressors. Finally, this unit features a filter/water trap—which is an optional extra on most commercial air compressors.

PM AIR COMPRESSOR

You can do all these things with this versatile 1-hp compressor and, happily, you can build it for less than \$200. **PM**

Compressor evacuates car's airconditioning system prior to adding new refrigerant (far left). At left, routine inflation of tires saves trip to gas station.

HOW TO ORDER PLANS

Send check or money order for \$5.95 to Air Compressor, Popular Mechanics Plans Library, Box 1014, Radio City Station, New York, N.Y. 10101. Allow two to three weeks delivery; for first-class mail send 75 cents extra.

Popular Mechanics is a publication of Hearst Magazines, a division of the Hearst Corporation.

HIGH-SPEED PHOTOGRAPHY

(Continued from page 64)

up), and develop it before taking action shots to make sure the exposure is on target.

If the aperture can't be adjusted, develop the film as though it has been "pushed" one stop. For example, with 400 ASA film, shoot it at 400, but process it at 800. Use film at least as fast as 100 ASA. Slower film will rob you of precious depth of field because you'll have to shoot at large apertures.

Speaking of depth of field, you'll have to do a bit of a balancing act between the need for depth and the need for short flash duration. Choose the widest aperture (smallest numerically) that will provide enough depth of field for the scene you're shooting; the wider the aperture, the shorter the flash duration and the faster the action you can stop.

Breaking-bulb photo

In the example of the hammer breaking the bulb (see photo, page 64), the trigger is simply two pieces of wire bent to touch each other at the desired moment. To build the trigger, fasten a wood block to a wooden base. Drill a hole in the end of the hammer handle and screw the hammer through the hole to the block so it can swing freely. Tape one piece of wire to the handle and one to the block. Glue or otherwise anchor a bulb to a cardboard background of contrasting color and position it near the wooden base. Bend the wires so they touch just after hammer makes contact with bulb.

For safety's sake, it's wise to place a piece of glass between the bulb and the camera, and to wear goggles. The camera must be secure so it doesn't move during the exposure.

Place the flash at its minimum operating distance from the bulb, as before, and aim it at the center. Connect the wires to the adapter. Working in subdued light, as always, open the shutter, drop the hammer and close the shutter.

By all means, bracket your shots and take notes to establish perfect exposure and technique. The key to successful stop-action photography is trigger design (see photo, page 64). Possible configurations include tripwires, photocells and sound triggers. With ingenuity, you'll be able to capture a leaping animal, a baseball going through a window, or a cream pie plastering a friend's face. The latter may require some coaxing, but the photo will be priceless. Be sure to make plenty of "test exposures" for that one! **PM**

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How the ~~X@!*~~ do they expect us to put out a volcano?

11:30 PM, April 13th, 1979. After five exhausting days fighting a fire aboard a ship in St. Thomas Harbor, The Coast Guard cutter, GALLATIN was slicing through Caribbean waters bound for New York and home. Charles E. Monsen, Quartermaster Third Class, was asleep in his bunk when a voice blared over the P.A. System.

"Attention all hands. The volcano on St. Vincent Island is erupting. We're now changing course and heading due south..."

He woke up wondering if he was dreaming. "Volcano? How the #\$%& do they expect us to put out a volcano?"

It was no dream. Within two hours, the GALLATIN was a mile and a half from the exploding crater, serving as a rescue coordinator for all forces.

As the booming volcano spewed its searing ash all over the countryside, Charles Monsen and his crewmates kept air and ground evacuation crews mobilized through radio contact.



"Hello, copter, do you hear me?"

"Yes...we just flew over the crater...it's unbelievable...all this boiling, frothing mud...like looking into a live generator..."

It wasn't until five days later, when the volcano finally quieted, that Monsen had a chance to think about his experience—"It was one of those things very few people see in a lifetime. Awesome!" And about the Coast Guard—"It feels good to be doing something useful."

We think he summed it up pretty well. Being useful, protec-

ting lives and property, helping others—that's what the Coast Guard is all about. And when it comes to helping yourself, there are a lot of great jobs in the Coast Guard. In fields like electronics, mechanics, navigation, aviation, communications and seamanship. And the Coast Guard gives you all the training you need to get your career off the ground.

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HINTS FROM READERS

Covers from plastic bottles



A felt-tip pen makes a heavy, highly visible cut line around soft-drink bottle.



Three dust covers were made from one bottle. Caps are from vitamin bottles.

You can recycle large plastic soft-drink bottles to serve as dust covers for camera parts or decorative objects. Soak the bottle in hot water and peel off the label. Mark a cut line with a felt-tip pen and divide the bottle into two parts with a sharp knife. Attach a cap for easier handling if you wish.

—Walter E. Burton

Flashlight support



This flashlight support made of a suction cup and photo-lamp clamp is invaluable at night when you need both hands to work, such as when changing a flat tire.—Ken Patterson

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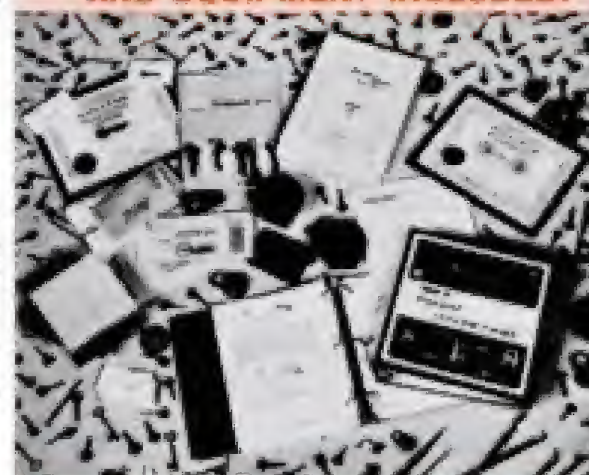
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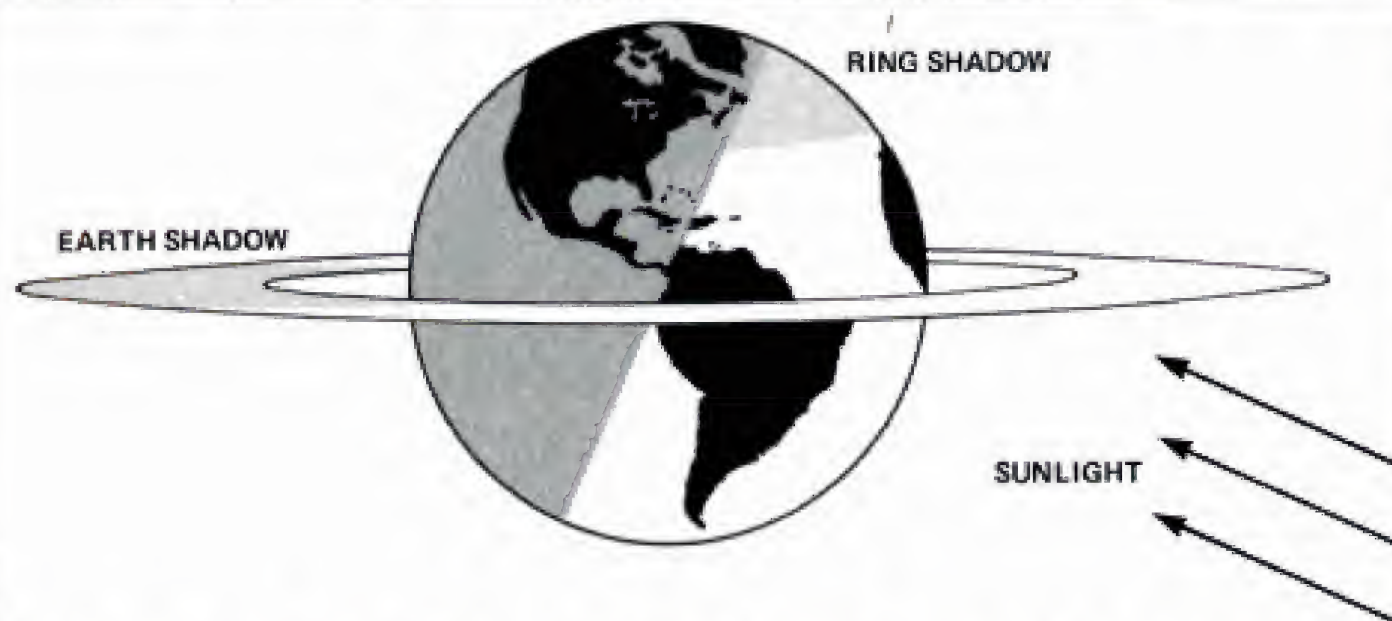
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SCIENCE WORLDWIDE



In winter, the ring system would have cast a shadow, lowering surface temperatures.

Earth's ancient rings

The Earth may once have been surrounded by a ring of particles shot from the moon, according to a NASA scientist.

Dr. John A. O'Keefe of the National Aeronautics and Space Administration (NASA) told PM that one or more volcanic eruptions on the far side of the moon some 34 million years ago may have discharged a rain of glass meteorites. Some fell to Earth's surface, O'Keefe theorizes, in a band running from the United States to a point far out in the Pacific.

But some, O'Keefe thinks, missed Earth and went into orbit around the equator, setting up a cloudlike band similar to the rings around Saturn.

In summer, when the sun hovered around the equator, the band had little effect on Earth's climate. But in the winter, when the sun dipped below the plane of the equator, the particles cast a shadow on the top of the northern hemisphere, which lowered temperatures. The ring system lasted up to several million years, the theory suggests. (See diagram above; continent outlines are for reference only: They had not yet formed into today's shapes.)

O'Keefe's hypothesis is consistent with evidence discovered by botanists that winters suddenly became more severe 34 million years ago—at about the same time a massive field of tektites, glassy fragments, is known to have formed on Earth's surface.

O'Keefe says he has encountered little opposition to his theory, first published in *Nature*. But some challenge comes from other researchers, who believe the tektite field originated on Earth when meteorites struck sandstone.

Sentinel for bad hearts

A new 9-ounce device the size of a deck of cards senses potentially fatal problems in heart function, and delivers a corrective shock to restore normal rhythm.

Researchers from Sinai Hospital and Johns Hopkins in Baltimore developed the device to overcome ventricular arrhythmia—a loss of effective pumping rhythm in heart muscle.

The equipment, surgically implanted in the upper abdomen, auto-



Tiny defibrillator restores heart rhythm.

matically performs the same function as a defibrillator, a machine run by hospital or ambulance personnel to shock the heart back into normal operation.

Five of six patients fitted with the automatic defibrillator overcame an extremely grave prognosis; the sixth person died for reasons that were completely unrelated to the device, a spokesman for the hospital told us.

The titanium-encased defibrillator carries lithium batteries capable of delivering about 100 discharges in the course of three years. An external recorder, triggered by the shocks, keeps track of the number of

pulses. The lifesaving shocks are not painful, researchers report.

High earthquake risks?

A new report on earthquakes by a group of university and industry scientists is critical of the way sites are selected for facilities such as nuclear reactors or dams.

The report by a National Research Council panel argues that developers of potentially dangerous structures sometimes lack sufficient data to judge earthquake risks. The panel, chaired by William J. Hall of the University of Illinois, said sites are "all too often" chosen before studies are made on seismic hazard, including a full investigation of significant earthquake faults.

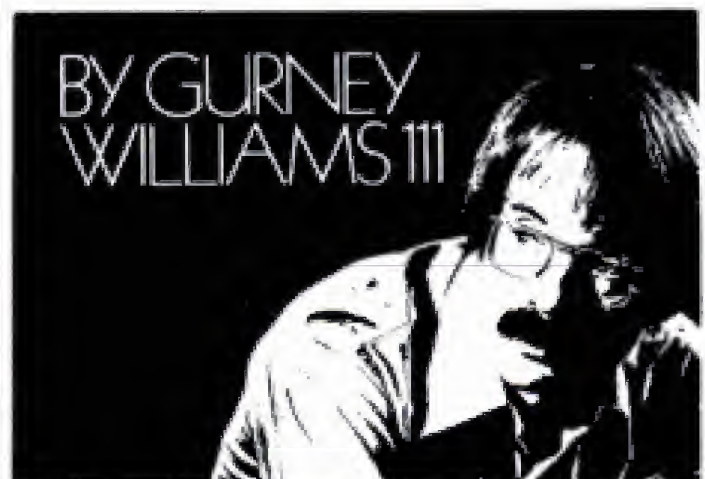
As a result, developers may be ignorant of risks or—on the other hand—so cautious that costs are higher than necessary. The National Research Council is the working arm of the prestigious National Academy of Sciences.

Supercold magnet

The search for quarks, elusive and theoretical building blocks of all matter, is expensive. Cornell researchers, for instance, commonly run up an electric bill of \$40,000 a month to power an electromagnet used in particle detection.

But in a month or so, costs of the quark hunt may drop, as Cornell begins using a new magnet chilled to temperatures close to absolute zero (-273.16°C). Cooling the magnetic coil eliminates most electrical resistance, cutting power requirements.

The magnet is used to bend the trajectories of charged particles resulting from collisions within an accelerator. Behavior of particles in a known magnetic field enables researchers to deduce their identities. Using supercooling, Cornell should be able to cut its electric bill for the magnet to about \$2000 a month—saving a cool \$456,000 a year. **PM**



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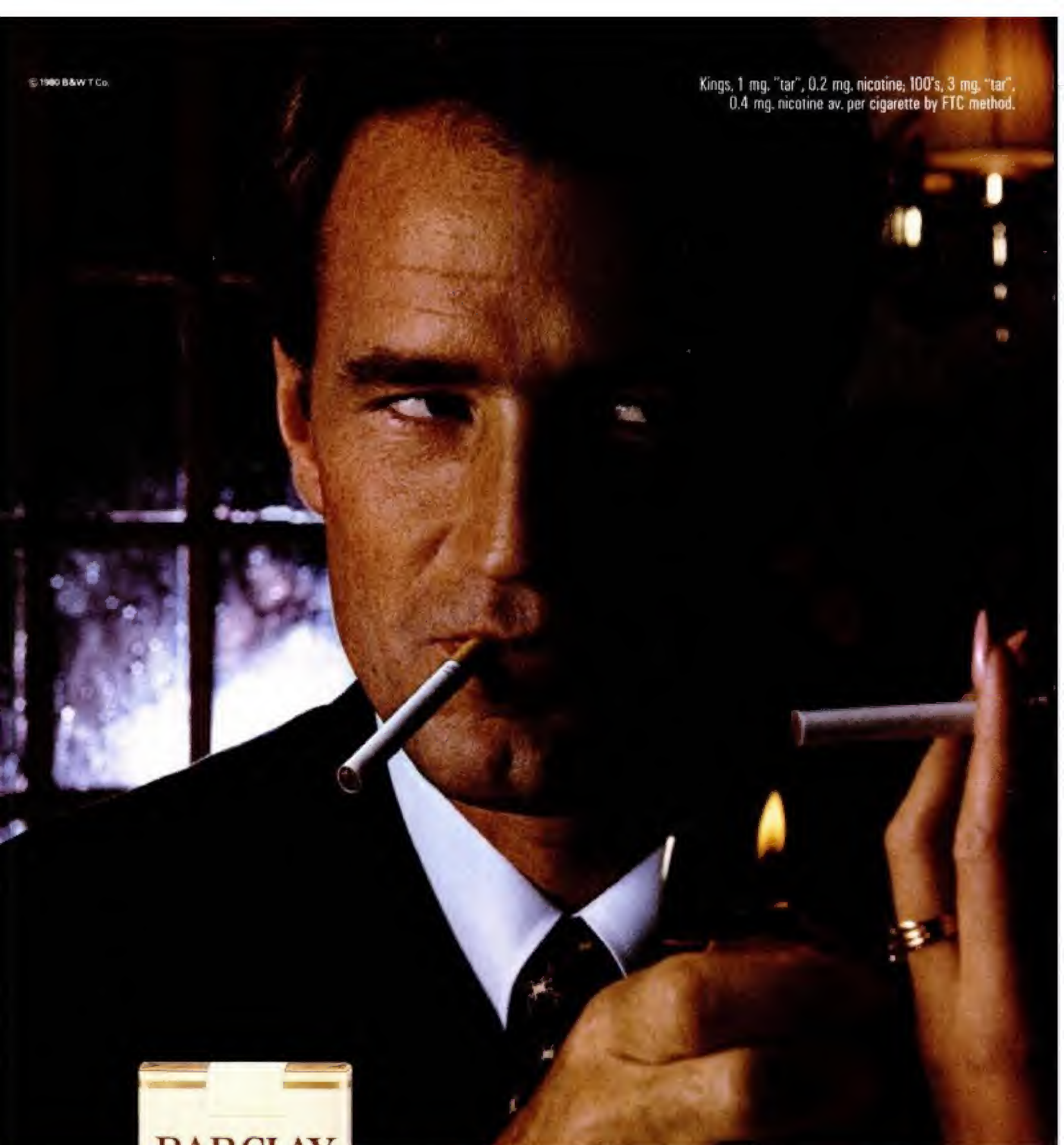
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Which fuel is best for you—now, in 5 years, in 10 years?



Nearly a quarter million families converted from oil to gas last year. Did they make a smart move?



In 1970, when domestic oil production peaked, imports and prices began to climb. Is the end in sight?



Anyone building a new house should heat it at least partly with the sun. Do retrofits, however, make sense?



With millions of acres available for wood harvesting, wood fuel appeals to many. Should you buy a stove?



Coal is the most abundant of our nonrenewable energy resources. Is the industry ready to deliver?



Electric rates are dependent on conventional and nuclear fuels. Is electricity worth considering as a fuel?

You can expect 25- to 30-year service from a new heating system. A logical question to ask is: "What will the energy situation be in the year 2000?"

The answers you get will help you plan a modification—even a conversion—of your present system. There is a catch, though. The answers you get often depend on whom you ask.

Oil people, for instance, project parity in the pricing of oil and gas by 1985—some say sooner. Gas people predict that the current disparity between gas and oil prices will grow through 1990 and beyond, despite the Natural Gas Policy Act of 1978, which makes deregulation of new natural gas possible as early as 1985. Nuclear industry spokesmen are promoting the use of electric heat pumps, but most unbiased experts see no end to spiraling electric rates.

The truth of the matter is that there is no one answer for everyone. Here are some facts to help you make a sound choice.

Is gas the answer?

Although many respected geologists believe that gas reserves in this country are enormous, most experts feel that we will do well to maintain current production levels through the '80s. The discrepancy between reserves and production exists because of one big unknown—the cost of getting unconventional reserves out of the ground. Nevertheless, a choice of gas seems like a sure shot when compared to relying on imported oil, given the chaotic state of international politics.

Gas has at least two other advantages. Its distribution network is more efficient than oil's and the new generation of gas-fired heaters has a slight edge in overall efficiency.

A common question for those who burn oil is

whether to convert to gas. The American Gas Assn. (AGA), which admittedly has an interest in selling gas-fired equipment, claims very attractive payback estimates. According to the AGA, to convert a relatively new oil unit to gas by installing a conversion burner can pay for itself in 1 to 2 years; adding a new gas furnace has a payback of 2 to 3 years, and a boiler, 3 to 5 years. If you need a new unit anyway, and gas is available, you would start saving almost immediately, the association says.

Major associations of oil suppliers and equipment manufacturers, on the other hand, warn homeowners that converting to gas may not solve their problems. There are areas where the price of gas is close to the price of oil—in New York City, for instance. The fact remains, however, that nationwide, the average price of gas is only half of that for oil, according to the latest figures from the Department of Energy.

Conclusion: Compare prices in your area. Note that one therm of gas (100 cu. ft.) equals 100,000 B.T.U.s and that one gallon of oil can provide 138,500 B.T.U.s.

Outlook for oil

For most of this century, we have taken oil for granted—and now we're paying for it. Although it's convenient and dependable as a fuel, it's a worrisome choice for the future. An unstable political picture in the oil-producing nations, as well as dwindling domestic supplies, spells continuing price jumps. From 1978 to 1979 prices rose 50 percent. Whether it happens again depends on our ability to conserve and to maintain domestic production levels. Fortunately, the major oil companies, as well as most experts, feel that enhanced

(Please turn to page 76)

WHICH FUEL IS BEST FOR YOU—NOW, IN 5 YEARS, IN 10 YEARS?

(Continued from page 75)

recovery and other unconventional ways of extracting oil will allow us to maintain current levels through the '80s.

The industry hope for the '90s and beyond is synthetic oil. The Energy Security Act of 1980 commits the government to a potential 90 billion dollars in financial incentives. Not all synthetic fuel, however, will be in the form of oil—much of it will be gas. Besides, the *target* for 1992 is equivalent to only one-third of current yearly imports.

Seriously consider backing up your oil-fired system with solar, wood and/or sound conservation measures.

If you do manage to cut your oil consumption, be aware that a few oil companies have begun to charge a delivery fee for "will call" customers. Such customers are not on a regular, automatic drop schedule. Delivering less than the optimum 200 gallons is less profitable for the delivery company, which is one reason for the extra charge. Unfortunately, this has the effect of penalizing users who conserve oil.

Is solar energy for you?

Obviously, solar space heating won't work for everyone. You must have the space, the proper orientation, adequate insulation—and the money to invest in a system. If you are building a new house, most of these requirements can be easily satisfied by good design and smart financing.

The National Solar Information Center recommends a passive solar approach to new building and estimates about 10 percent increased building costs for a passive solar house. Some innovative passive home designs, however, cost no more to build than conventional designs.

Most of us are living in homes designed with little regard for utilizing the sun for heat. In many instances, solar-heat retrofits are possible. The problem is that active systems cost about \$8000 to \$25,000 installed.

Federal tax incentives will chop up to \$4000 off the price tag. State incentives also will help, but for many, the economics are just not attractive. The real shame is that many passive retrofits do not qualify for tax write-offs.

On the plus side, the Solar Bank Act of 1980, if funded, will encourage bankers to provide low-interest loans to homeowners who are interested in going solar.

For the latest information on solar legislation and other solar-related questions, call the National Solar Information Center at 800-523-2929. In Pennsylvania, call 800-462-4983. In Alaska and Hawaii, call 800-523-4700.

Wood is cheap for many

Wood is plentiful in many regions of the United States. The option is particularly attractive in New England, where about half of all homeowners use a woodburner.

Equipment payback may be faster than you would guess. Wood prices, unlike those of other conventional fuels, are dependent on local supply and demand.

Thus, prices will likely vary from area to area. They won't necessarily rise as the price of oil goes up. In fact, wood prices per cord actually declined in some areas of the country this year.

According to Andrew Shapiro of the Wood Energy Research Corp., wood and related fuels may account for as much as 7 to 8 percent of total U.S. energy consumption by 1990. Wood fuel's continued development depends on the acceptance of more sophisticated wood-burning equipment and on the development of pelletized fuel for ease of transportation and use.

Electricity—the rich man's fuel

Sure, electricity is convenient and clean, but you have to pay through the nose—and it's likely to get worse before it gets better. The main reason for this is that, in terms of total energy efficiency, electricity is only between 25 and 41 percent efficient. In other words, losses due to distribution and conversion from other fuels are heavy—the greatest of any of the fuels that have been mentioned here.

The once glowing promise of cheap kilowatts from nuclear energy has turned to wishful thinking. Currently, nuclear energy has no price advantage over coal in the production of electricity—and many eventual costs, such as the cost of waste disposal or of a large-scale accident, cannot be accurately reckoned.

For both environmental and economic reasons, no contracts to build new nuclear power plants in the United States have been made since 1978 and many previous orders have been canceled. It takes 12 years for a new nuclear powerplant to come on line.

Thus, for the foreseeable future, electricity is not a smart choice for

home heating. It does compete as a convenient, flexible supplement to some other primary heat source.

The lowdown on coal

Coal, looked upon by many as a transitional fuel which will buy us time to develop cleaner alternatives, is not yet available to large numbers of consumers. As large industries and utilities convert to coal, many nearby abandoned coal yards will spring back to life. This will make coal deliveries possible to more consumers.

However, the coal industry is not geared up for expanded production. In addition, coal as a fuel is beset by health and environmental problems. Since it is a labor-intensive industry, it is also subject to strikes and continual price hikes.

The best advice to the homeowner interested in burning coal is not to go whole hog unless availability is assured. Even then, it would be better to consider the other alternatives first.

Some conclusions

One general rule is clear from these observations—the most local energy source that's subject to the fewest middlemen, least transmission costs and least conversion losses is the homeowner's best bet. If you live near a hydroelectric plant or where wood can be had cheaply, your decision may be obvious.

If the answer is not so obvious, the multifuel approach is one way to cover your bets (see *Now: Multifuel Heaters Let You Choose the Fuel You Burn*, page 118, Oct. '79). The problem is that these units are at least twice, and often three times as expensive as conventional single-fuel boilers and furnaces. And they don't qualify for a federal tax break.

Paybacks on the multifuel units, however, are acceptable and, more importantly, the units give you great flexibility.

No matter which route you take, one thing is certain—there are no simple answers. It's doubtful that some sudden technological fix will solve the problem.

Aside from choosing the fuel best suited to your home and area, good conservation practices will help lessen the burden. Many experts believe that conservation can, in fact, reduce our nation's energy consumption by 30 to 40 percent. We're a long way from it, but it can be done.—Joseph R. Provey, Assistant Home and Shop Editor; research assistant, Ben Dunlap.



SUPER WATCH

Don't be fooled by the price. This LCD Dual Alarm Chronograph is probably the best as well as most useful watch on the market today.

This watch is in a class by itself. With every conceivable convenience ... unmatched feather-light comfort ... and rugged dependability with matching, trim-slim styling.

And it's priced so low, it makes sense to own as an every-day watch you can wear without worrying or as an extra watch you use only for running or when you're working around the house or for its wake-up alarm and second timekeeping zone when you're traveling.*

What's amazing is that it gives you TWO of everything other watches selling for ten times as much boast of when they have just one. And it includes additional conveniences, like a count-down timer; so, no other watch, at any price, does as much or does it better! And this watch is guaranteed for ONE full year.

WORLD CLASS ACCURACY: First and foremost it's guaranteed to be accurate to within seconds a month, three-minutes-a-year. You can be certain the big, easy-to-read display with the hour, minutes and running seconds is right on time—to the second.

Your watch also gives you the day and date at a glance, with no button to push, adjusting automatically for the number of days in any month (including leap year). Then, so you can see easily in the dark or when it's dim, there's a built-in night light.

3-YEAR BATTERY: And this is one watch you won't have to worry about for a long, long time. The battery is warranted to last for a full three years.

TWO-TIMING: What is more, you get a second timekeeping zone. A convenience you'll really appreciate when you travel or when you're doing business with a firm in a far-away city. Plus a two-note chime you can set to go off on the hour to keep the time from passing you by.

24-HOUR ALARMS AND PERSONAL REMINDER SYSTEM: The alarm can be set in an instant for any minute of any hour. The precision of a digital alarm is simply unbeatable. If you want, you can leave this alarm set for the same time every day because there's a SECOND alarm as well. With two alarms you'll be able to schedule your day and stick to your schedule more easily and surely than ever before.

30-MINUTES AND COUNTING: In addition, inspired by the Space Center, you also get a 12 hour to

one minute count-down timer. Really, a third alarm, it's a lot easier to use if you want to be reminded your time is up or you have to act—when you've promised to call back in half-an-hour, for example, or have to put another quarter in the parking meter. With a count-down timer, you can be sure you won't goof, and you'll know exactly how much time you've got left. (If nothing else, those steaks you like rare and your three-minute eggs will never be over-done again.)

CHRONOGRAPH SYSTEM: With 1/100th of a second precision for up to 12 hours, the dual chronograph literally enables you to command time to stand still. With the stopwatch you can time any event in its entirety—from a speech you're preparing to the length of a phone call you're making to the time it takes a passer to set up and throw. (A buzzer sounds when you start or stop the chronograph. A nice feature since it means you won't have to check to see if it's timing.)

You can also measure sections of an event, like the time for the 1/4 or the 1/2 or the times of individual finishers in a race. This is Lap Time. In this mode the chronograph continues timing an event in memory at the same time that it's stopped to give you a reading on a particular segment.

You'll be able to use either of these modes in minutes, find innumerable uses for both in your business and personal life within days.

SUPER LIGHTWEIGHT: Even with all these functions, you'll hardly know you're wearing a watch. It's that light and comfortable. Less than one ounce.

The case, which is exceptionally handsome, is made of a high-impact, virtually impervious black plastic. An advance almost as remarkable in its way as those in the microprocessor that controls the watch's functions.

THE MOST IMPORTANT FEATURE OF ALL

Here's a watch, then, with phenomenal accuracy and totally unique capabilities; a watch that passed every quality-control test with flying colors and stood up to 10 years' of simulated-use tests. And all it costs is the amazing low price of just \$29.95!

It just didn't seem possible to us either. But the manufacturer, who's been making components for years for many of the major watch companies, including some of the biggest, best-known names, explained:

"Of course, you'd expect it to sell for 100% more. But, once this new kind of case became available, we knew we could produce a chip (microprocessor) superior to any we made for anyone else, and sell it for far less than you'd expect by assembling the watches ourselves and selling them direct-by-mail, eliminating the middleman's mark-up in both manufacturing and selling."

As proof, in about a year, a major name in the watch world plans to buy this module and offer this same watch through normal retail outlets for at least \$60 and maybe more.

ANOTHER CHOICE

This gave us an idea. What if the same watch was put in a stainless steel case with a stainless steel band. After some figuring the manufacturer said he'd include a deluxe mineral glass crystal, so the watch would be absolutely superb, and all we'd have to charge is just \$59.95.

CALL 800-228-5959

(Nebraska residents call 800-642-8777)

(Numbers in operation 7 days a week, 24 hours a day)

So, that's your choice of the matte black watch or the watch in stainless steel with a stainless bracelet.

What is more, since you can't get this watch in any store, we'll send it to you to wear for 30 days without risk or obligation. If you're not absolutely satisfied, if the accuracy isn't exactly as we say, if you don't find two timekeeping zones, the two alarms, the dual chronograph, the count-down timer as useful and convenient as you supposed, if people don't praise the look of the watch you're wearing, send it back for a complete refund. No questions asked.

To order with any major credit card, simply call the toll-free number above. But we'd prefer, in this instance, since the price is so much lower than for anything else we sell, that you send us your check to the address below. Just be sure to specify the Black Watch or the Stainless Steel Alarm Chronograph and include the proper amount. (Include \$2.50 for shipping and handling and in Illinois the 6% sales tax.)

Either way, you'll be getting a watch as good if not better than any watch in the market today. At a fraction of the usual price. If that isn't class, what is?

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CAR CLINIC

SOLUTIONS FOR MECHANICAL HEADACHES

BY
MORT SCHULTZ



Betwixt and between

Can my 1962 Chrysler Newport use radial tires? Some people say yes—others say no. I'll believe what you tell me.—Frank G. Tarpila, Trenton, N.J.

There's no safety or mechanical reason why you can't equip your car with radial tires. Just be sure to use them on all four wheels. The only drawback may be a loss of comfort. Since the suspension system is not designed for radial tires, you may get a harsher ride than you would with bias tires.

Making a case

I own a 1978 Ford F-150 four-wheel-drive pickup that's seldom used in 4wd. Yet, the transfer case leaks. Gasket and seals have been replaced twice—but within 1000 miles after repairs are made, the case starts leaking again. Is there a Ford service bulletin that tells how to fix this thing once and for all?—John A. Troy, Benton, Wis.

No, John, there isn't. But there is a solution. Unless someone butchered the gaskets in replacing them (not likely—the leak wouldn't wait 1000 miles to reappear), the cause of the trouble is probably uneven transfer-case mating surfaces. Remove the cover and replace the gasket again, but this time apply RTV (Room Temperature Vulcanizing) silicone plastic sealer to surfaces before installing the gasket. The sealer, which is made by Dow Chemical and General Electric, fills voids in the metal. If you're doing the job yourself, you can buy the sealer from an auto-supply dealer. If the job is to be done by a mechanic, make sure he uses this sealer.

Holey hoses

I'm writing about a recurring coolant leak from a 1978 Chevrolet Monza 2.5-liter (151-cu.-in.) engine. According to a radiator shop foreman I spoke to, this engine, which is also used in Buick Skyhawk, Oldsmobile Starfire and Pontiac Sunbird, has a reputation for this sort of thing.

My problem popped up six months ago, when I noticed coolant leaking from a crack in the upper radiator-hose nipple. I had to have the radiator removed and the crack soldered shut. Two weeks ago, I again spotted a leak. Same problem—same fix.

According to my friend at the radiator shop, the trouble seems to result from the upper radiator hose pulling on the radiator nipple. Although the GM hose is preformed to help reduce stress, pulling action occurs in starting and stopping when the engine shakes more than at other times. The preformed hose, which is relatively short and rigid, is pulled back by the engine, placing stress on the radiator. The foreman recommended I replace the GM hose with a longer, more flexible hose, which may absorb the shock better. What do you think?—Don Sexton (no address given).

I think it's worth a shot. But make sure the new, longer hose doesn't rub against a belt, which may result in wear-through and an immediate, complete loss of coolant. You don't want to substitute a relatively small leak for a gusher.

About face

The seat-belt-interlock system of my 1974 Dodge Dart no longer works,

and I'm having a hard time trying to find someone who knows how to disconnect it. I got the runaround from several dealers. I wrote Chrysler and was told to buy the service manual, which I did, but it doesn't contain information about disconnecting this system.

The only way that I can start the engine is to open the hood and press the emergency start button, which is inconvenient and doesn't always let the engine start. Please, to whom can I turn?—John Warren, Johnston, R.I.

You're facing in the right direction now, John, by writing to Car Clinic. Go to a dealer, but this time read chapter and verse to the service manager about where he'll find the information his mechanic needs to override the interlock system. This is service bulletin 23-06-75. It describes how to modify the seat-belt-interlock control unit so the seat-belt system is deactivated.

Temper, temper

The electric wire to the rear-window defroster of my 1974 AMC Hornet Sportabout broke. The AMC dealer says he can try soldering it, but warns that the temper of the glass may be affected and the window may shatter during, or a few days after, the operation. Do you know of any safe way to repair the circuit?—L.H. Van Winkle Jr., Streator, Ill.

For those of you unfamiliar with this circuit, there are two wires connected to the rear-window defroster grid. One is a "hot" lead, and the other is the ground. Wires in a station wagon or a hatchback may break eventually, because of the strain put on them by the tailgate or hatch being opened and closed. Wires can also be broken by golf clubs, plywood panels or luggage being jammed

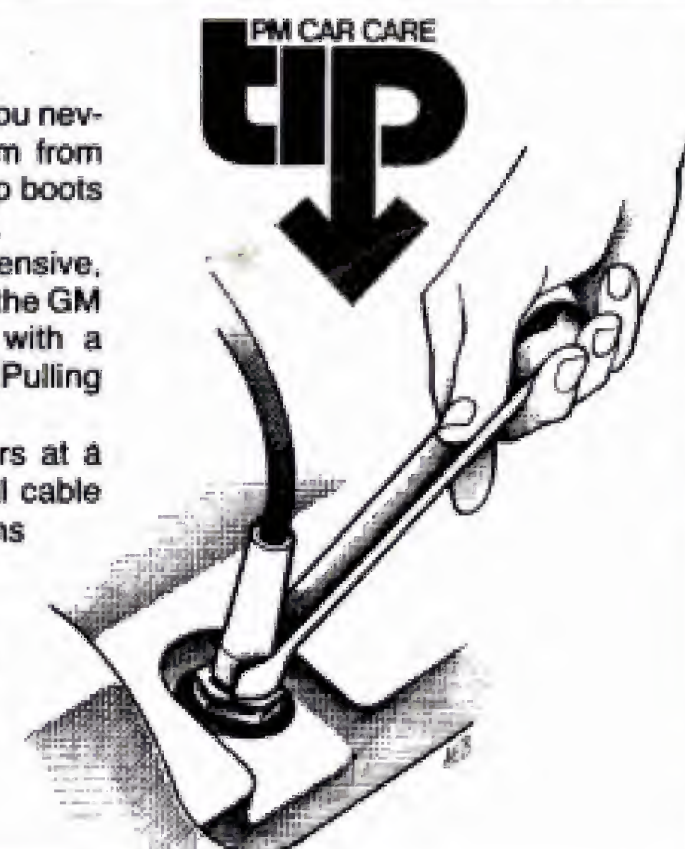
(Please turn to page 80)

A change of sermon

If you've heeded my preaching over the years, you never pull on sparkplug cables to disconnect them from plugs. Instead, you use sparkplug pliers to grasp boots and twist and pull on them—not on the cables.

Now, though, instead of pliers, which are expensive, you can use a tool I've come across. Devised by the GM Service Research Center, it's a boot puller with a crimped neck that hooks the bottom of the boot. Pulling up on the tool pops the boot off the plug.

Although you must order two of these pullers at a time, they're still less expensive than the usual cable pliers. Send \$4.50 for two pullers to Borroughs Tool and Equipment Corp., 2429 North Burdick St., Kalamazoo, Mich. 49007. Refer to tool No. BT-7901. If you can get a mechanic friend to go in with you on the order, you can split the cost. Or the extra puller could make a much appreciated gift.



If you have a GM car with a four-barrel carburetor, you can

SAVE GAS

with these patented GAS SAVER carburetor rods!



Here is a brand new product. It is patented. (U.S. Patent Nos. 3,485,482 and 4,157,367.) It is designed to make gasoline burn more completely and efficiently in four-barrel carburetors on General Motors cars, trucks and vans, model years 1967 through 1980. The result is more miles per gallon.

The principle is amazingly simple: Get more air to the gas. Those factory-installed rods you now have are solid metal. GAS SAVER rods — while they look similar — are actually hollow *tubes* with an air duct at each end. When you reach approximately 35 mph, GAS SAVER rods start to meter and atomize the gasoline going to each cylinder.

You can understand that gasoline atomized into smaller, miniscule droplets burns more completely, producing more power.

With less unburned fuel, this also reduces the amount of carbon monoxide, hydrocarbons and nitrus oxide emissions from your exhaust system. By reducing hydrocarbon emissions, you get cleaner combustion and increased power. This simply means more miles per gallon and less air pollution.

Gas savings will vary

Laboratory as well as actual on-the-road driving experience has indicated gasoline savings. The savings have varied widely. This is due to the wide number of variables that effect fuel economy. For example, the condition of the engine and whether or not it is in tune are factors. The load being carried (number of passengers) and inflation of the tires, the condition of the road surface, wind conditions and the driving habits of the person at the wheel all have effects on gas mileage. But the GAS SAVER rods *will improve your gas mileage*. Try them for ninety days *after* you have established a mile-per-gallon performance record for your car. If your average gas mileage over the ninety days doesn't show an improvement, send the rods back to us and we'll cheerfully refund your money.

GAS SAVER rods will not steal from performance

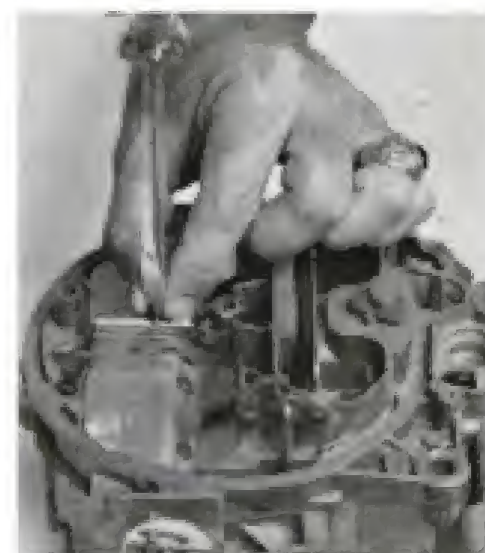
The GAS SAVER rods are designed for only one thing . . . to save gas. You should not notice any other change in your car's performance. The rods will not need replacing for the life of your car. They are precision-made components and will not harm your engine. If you trade or sell your car, you can take the GAS SAVER rods out, put the original rods back in and install the GAS SAVER rods in your new car if it's a GM car with a four-barrel carburetor.

Installation is simple

It takes only a screwdriver, a few minutes (most people require less than five) and no special skills or automotive knowledge. The kit comes complete with a step-by-step illustrated instruction sheet that will enable you to install the rods yourself. Your gas station attendant could probably do it while the tank is being filled. Shown below are two photos from the instruction sheet.



Unwind the thumb screw at the top center of the air cleaner. Lift the air cleaner to expose the top of the carburetor.



With a screwdriver, remove the single screw that holds down the "Y" shaped stamping on the "butterfly" valve.

We're sorry, GAS SAVER WILL NOT FIT ALL CARS

The GAS SAVER rods will fit only 1967 through 1980 General Motors cars with four-barrel carburetors. (Cadillac, Oldsmobile, Buick, Pontiac and Chevrolet.) If you're not sure your GM car has a four-barrel carburetor, check your owner's manual or ask your dealer or gas station service man. Not available to California residents.

ORDER your GAS SAVER rods today

To order the patented GAS SAVER carburetor rods, fill in the coupon below and send it with your personal check or money order for \$29.95 for each set of rods you want to UNITEC, P.O. Box 4913, Fairview Park, Ohio 44126. GAS SAVER rods carry a no-questions-asked money-back guarantee. If you are not completely satisfied that the GAS SAVER rods have improved your gas mileage, put the used rods in an envelope with your name and address, mail them to UNITEC and a refund check will be sent to you by return mail.

PM02

UNITEC, P.O. Box 4913,
Fairview Park, Ohio 44126

I want ☐ sets of GAS SAVER carburetor rods. I am enclosing a check ☐ or money order ☐ for \$29.95 for each set. Please send my GAS SAVER rods to:

Name

Address Apt.

City

State Zip

CAR CLINIC

(Continued from page 78)

against them, or kids playing with them. If you want to keep wires connected for as long as possible, use some finesse in opening and closing tailgates and hatches, and keep things and the kids away from them.

There is a repair kit for fixing the heater grids. It's sold under the AMC name, and a friend in AMC service engineering says, "It works great."

The repair kit contains a brush-on conductive material, which resembles a heavy, silvery paint, and line grids of various sizes that resemble stencils. What you do is locate the break in the grid and buff the surface with steel wool or sandpaper to clean the area. Then lay a grid in place to serve as a guide, while you brush on the conductive material to close the break. You can use the defroster immediately. In fact, heat helps the material to set more rapidly.

The name of the kit is "Grid Repair Kit, Heated Rear Window." The AMC parts group under which it's listed is 3.774, and the part number is 8123332. Since the list price is

\$20.20, I suggest that before you buy the kit you find out how much an AMC dealer will charge to repair a busted grid. It may be less than \$20.

Incidentally, the repair kit is intended for all cars with heated rear windows—not just AMC models.

Deporting Russian roulette

I have a 1973 Ford Ranch Wagon, which has power-boosted front disc brakes and rear drum brakes. In stop-and-go traffic, the brakes work okay on one application, but then the pedal goes to the floor on the next ap-

plication. If I hit the pedal again, the brake will work again. The system has been gone over with a fine-tooth comb, but no luck. Help, please. So far, the brakes haven't failed me in a tight situation, but having a brake system that works on a hit-or-miss basis is like playing Russian roulette.—Robert N. Ribicki, Lowell, Ind.

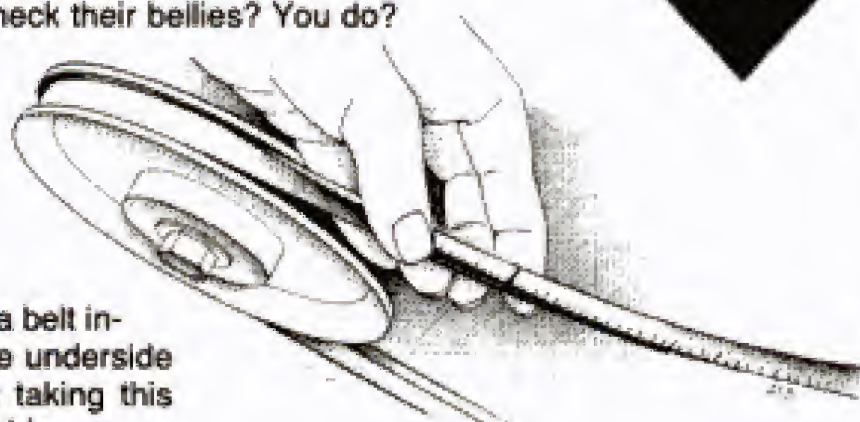
I can think of three reasons, other than a brake-fluid leak, for this "yes there is, no there isn't" brake problem. One reason is brake-pad wear, which causes excessive piston travel. Since worn brake pads have to

Belly flop

Another thing I've been preaching for a long time is drive-belt integrity. But did you listen? Okay, okay—maybe you did. So you check belt tension periodically and give belts a glance to see that they aren't frayed or sprayed (with oil).

But do you twist belts 180° and check their bellies? You do? Good, because this is where the action is, and this is where the first signs of damage appear. By the time damage spreads topside, it may be too late to prevent a busted belt that will leave you stranded.

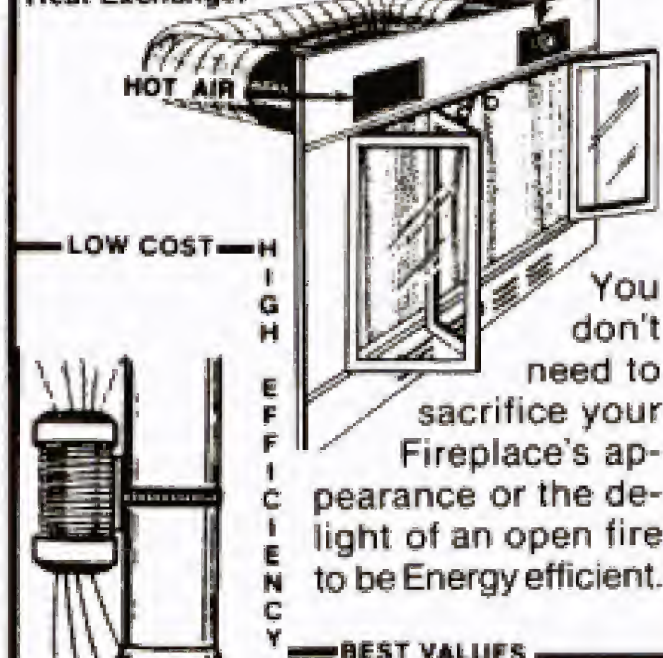
Remember, the next time you do a belt inspection—belly up. Check the entire underside for cracks, glaze, frays and oil. By taking this simple step, you could head off trouble.



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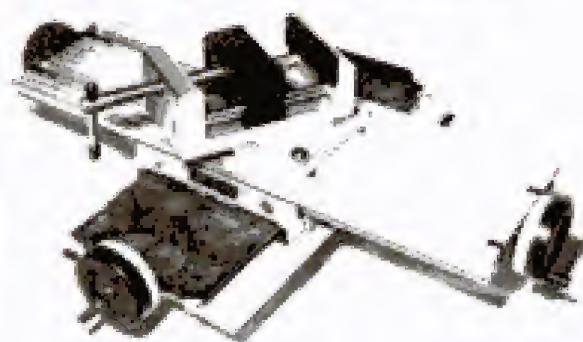
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travel farther than normal to engage the rotors, pistons have to travel farther, which means more fluid is needed to displace the pistons.

That's why, perhaps, in one instance you won't have a brake pedal, but hitting the pedal again allows the needed fluid to be pumped into the cylinders. If pads are worn, the solution is to replace them.

Loose wheel bearings will also cause the trouble by allowing the caliper to ride off the rotor. This results in greater piston travel, as pistons expand to push the pads against the rotor. The longer travel necessitates a greater amount of fluid to fill the cylinders. The solution is to adjust wheel bearings according to the manual.

This leaves possibility No. 3, which is a bypass fluid leak in the master cylinder. A master-cylinder leak is difficult to detect, but the fluid eventually has to go somewhere. If the problem exists long enough, you will notice a drop in the master-cylinder fluid level and brake fluid dripping into the passenger compartment. The solution is to replace the master cylinder.

Investigate this last possibility first, looking for signs of leaking

brake fluid or a drop in the fluid level. If the master cylinder checks out okay, move on to the wheel bearings and brake pads.

Mighty Mityvac

In several of your recent articles, you've mentioned a hand vacuum pump. For example, you described the use of this tool in your recent two-part article, How to Tune Up for Top Fuel Economy (page 27, Dec. '79 and page 27, Jan. '80). Tell me, where can I get a hand vacuum pump?—Pete Pantutamangkim, Canoga Park, Calif.

The tool is commonly referred to as the Mityvac. If you can't get it from a dealer of auto supplies and accessories in your area, write the company that makes it and ask the location of the nearest source of supply.

The company is Neward Enterprises Inc., 9251 Archibald Ave., Cucamonga, Calif. 91730. Address your letter to the attention of the sales department.

GOT A PROBLEM WITH YOUR CAR?

Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be published in the column.

Safety and service tips

■ Ford Motor Co. found that fires in 1980 LTD police cars operated by the New Orleans Police Dept. were caused by overfilled automatic transmissions. Excess fluid, possibly combined with improperly seated transmission-fluid dipstick caps, allowed fluid to escape, hit the hot exhaust and ignite. Enough said.

■ Loose rubber bumper strips can be secured with a repair kit available from GM dealers. These strips often pop loose at the ends. The kit lets you make repairs without tools and avoid bumper disassembly. The kit carries part No. 593249. In addition, you'll need 3M adhesive cleaner (8984) and adhesive (8001). Instructions are included in the kit.

■ Chrysler Corp. tells us that clicking noise at road speeds in fourth gear coming from an Omni or Horizon manual transaxle is a sign of a chipped reverse idler gear. Service bulletin 21-15-80 tells your dealer what to do.

■ The National Highway Traffic Safety Administration has opened an investigation into possible gearshift-lever assembly failure of 1976-80 Chevy Chevettes, which may have resulted in four accidents. According to the report, the saddle pin of the shifter shaft assembly may bend or fracture. If bent, the gearshift lever will be loose or will bind. If the pin breaks, you won't be able to shift. Although no recall has yet been announced, be cognizant of the way your shift lever works. If you notice excessive play or binding, get it checked. **PM**

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THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS

Lock-plate compressor tool

If you've tried to replace a switch for directional signals or hazard-warning lights on one of the late-model cars, you've probably gotten as far as removing the steering wheel with your trusty \$3.98 puller, and perhaps a plastic cover plate on the top of the column. Then you encountered a spring-loaded plate held by a C-clip in a groove on the steering-wheel shaft and had no way to remove it. This setup is used on virtually all GM cars and many Chrysler and AMC cars, too.

You can now do the job yourself with a \$13 pushing tool that presses down on the lock plate so you can reach the C-clip. Pry out the clip with an awl and thin screwdriver, release pressure on the lock plate,



This lock-plate compressor allows fast and easy access to turn-signal switches.

lift everything up and out, and the switches are there for the unscrewing and replacement.

Reverse the removal procedure to install the lock plate and new C-clip. This tool is made by Lisle Corp., Clarinda, Iowa 51632. There are also adapters for all steering columns, including the new metric ones.—*Paul Weissler*

Traction action

Getting stuck in snow is one of the inconveniences of winter driving. One neat product we just used which will get you unstuck in a hurry is called X-Tractor.

It's a two-pound polyethylene ramp with large, jagged teeth on the bottom, and triangular-shaped ridges on top. The teeth get a good grip on the loose stuff, whether it's ice, snow or mud, and you drive right out.

It certainly beats rocking your car back and forth and running the risk



Plastic ramps provide a safe, sure grip for tires that are in snow, mud or ice.

of doing some damage to the drive train.

They're available by mail for \$11.95, plus \$2.25 for postage, from X-Tractor Corp., Box 6838, Bridgewater, N.J. 08807.—*T.A.*

Economy manifold

Edelbrock, long associated with high-performance equipment, has used its technology to develop an economy manifold for most V8 engines.

This line of manifolds, called S.P.2-P., has been certified as a legal replacement part by the strict California Environmental Protection Administration. The average mile-



Manifold from Edelbrock is a simple bolt-on installation, gives mileage a boost.

age increase on cars with V8s is about 17 percent.

The installation requires no modifications and can be made with existing brackets, linkage and carburetor. It also uses all stock emissions hardware.

If you're interested in more information, contact Edelbrock Corp., 411 Coral Circle, El Segundo, Calif. 90245.—*T.A.*

Torx bits

All late-model GM cars and trucks use a new Torx fastener system to secure headlights, trim, signal lamps and door hinges. If you've ever tried to get them out with a

Phillips screwdriver, you know that it's almost impossible.

The right tools for this job come from Dresser Industries and are neatly packaged to cover all the sizes you'll need. The cost is \$22.39.



Torx bit set will easily remove new-type fasteners used on all GM cars and trucks.

Available from local dealers or Dresser Industries, 3201 North Wolf Rd., Franklin Park, Ill. 60131.—*T.A.*

Dent puller

If you can get behind a sheet-metal crease, it's pretty simple to knock it out. If you can't, you probably end up doing what I have: Drill holes a couple of inches apart along the crease and use a slaphammer. It leaves a mess that takes forever to smooth out and fill in.

A pretty clever answer is a line of kits called Two-Holer. You drill just two holes, insert a Z-shaped bar through one and turn the bar so one shank is flat up against the back of



Z-shaped bar in dent-puller kit pulls out long creases on damaged body panels.

the crease. Into the other hole you insert the hook tool, which hooks onto the shank. Then pull straight out. The kit is about \$34. For a dealer near you, write Wivco Tool Manufacturing Co., Box 398, North Chicago, Ill. 60064.—*Paul Weissler*

Ford Granada 1981. Built for a changing world. Designed with a commitment to quality.

In a world calling for change, no American-built sedan has changed more for 1981 than the new Ford Granada. Count the ways:

Granada is smaller than last year.

Granada has more interior room than last year.

Granada has rack-and-pinion steering this year.

Granada has a new type of suspension for this year.

And, best of all, Granada's efficient 4-cylinder engine for 1981, combined with its new sleek aerodynamic styling, gives it the best mileage in its history—21% better than last year!

23

EPA
EST
MPG

34

EPA
EST
HWY

For comparison. Your mileage may differ, depending on speed, distance and weather. Actual highway mileage and California ratings lower.

Granada is built with Ford's attention to detail. Every seat is fitted by hand

and every door is adjusted by hand. Every car is examined by at least 38 quality-control inspectors. That's attention to detail you can see, feel and hear.

Your Ford Dealer can discuss buy or lease arrangements and tell you about Ford's Extended Service Plan.

FORD GRANADA

FORD DIVISION



The New Ford Granada

NEW NOW for home and shop



A

A The 9999 units of this limited-edition Coffee-Time coffeemaker are handcrafted in black with the owner's name in gold. Each unit has an 8-cup capacity and a quiet brewing system designed to make very hot coffee. A Stop 'N Serve feature (in circle) stops the brewing cycle up to 20 seconds while you serve a cup or two. A digital clock programs automatic brewing up to 24 hours in advance. There is also a special brewing cycle for making only one to three cups of fully brewed coffee. Coffee-Time limited edition is \$200, from Robert Krups, North America, Allendale Industrial Park, 7 Pearl Ct., Allendale, N.J. 07401.

B You can wrap M-D duct insulation around both warm- and cold-air ducts in the attic and basement to improve heating and cooling efficiency, thereby reducing utility bills throughout the year. The duct insulation has an inner layer of 1/8-in., closed-cell insulating foam covered by a protective outer layer of thick, heat-reflective aluminum foil. This combination stops air leaks and insulates ducts from temperature extremes. The insulation is self-adhesive and easily cut with household scissors. It comes in 12-in. x 15-ft. rolls (\$11) from Macklanburg-Duncan Co., Box 25188, Oklahoma City, Okla. 73125.



D This simple yet clever clamp enables installers of nonmetallic sheathed cable to satisfy the strain-relief requirements of the National Electrical Code. Merely snap the clamp into place in any cable-entry knockout of a Bell nonmetallic electrical box. Use the clamp's first groove in a 1/2-in. knockout, the second groove in a 3/8-in. knockout. Push the cable through the clamp and it is automatically locked into place. If the cable entrance is ever changed, you can reuse the clamp. Cable-Lok clamps are listed by Underwriters Laboratories Inc. A card of 10 clamps is priced at \$1.60. They're made by Bell Electrical Products, Square D. Co., 2600 West 50th St., Chicago, Ill. 60632.

C This vapor-compression water heater may reduce the cost of heating water up to 60 percent, according to its maker. Similar to an air conditioner, the water heater extracts heat from the environment. The unit then transfers this heat to the hot-water tank. The Heat Re-Cycler is a self-contained, add-on appliance that connects quickly to an existing electric hot-water system by hoses; it plugs into a 115-v. outlet. The maker is conducting a tax-credit campaign, which, if passed, would entitle users to a tax credit of up to 40 percent for the \$600 unit. Heat Re-Cycler is manufactured by Fedders Corp., Edison, N.J. 08817.

B

D

C



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NEEDS A LITTLE COMFORT.**



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That Cigarette Smoking Is Dangerous to Your Health.

12 mg "tar," 0.8 mg nicotine av. per cigarette, FTC Report Dec '79
Box: 12 mg "tar," 0.8 mg nicotine av. per cigarette by FTC Method.

7 major causes of highway accidents and how to avoid them

The majority of highway fatalities *can* be prevented. But it takes more than just obeying the speed limit.


by Moss Miller

On July 10, 1980, a 20-year-old Long Island man, upset over losing his job, went on a wild rampage through a state park in a stolen car, killing three people and leaving a half dozen others injured.

The young man's wild ride began when he hopped into the car of an airline employee who was about to pull his boat onto a trailer. He raced the car and trailer through the narrow twisty roads of the park and rammed head-on into the first car that came his way. In it were a woman and three children. They were injured, but none of them fatally.

When other motorists stopped to assist, the man, then injured and bleeding, jumped out of his car and into one of the cars that stopped. In the back seat were three children. He took off and reached speeds of 80 mph around the park, left the road, crashed through a fence and slammed through a picnic area. He smashed into a crowded refreshment stand. Two young boys near the stand were killed on impact, and an older man was dragged 200 feet and crushed.

After the tally of death and injury is recorded, after the bodies



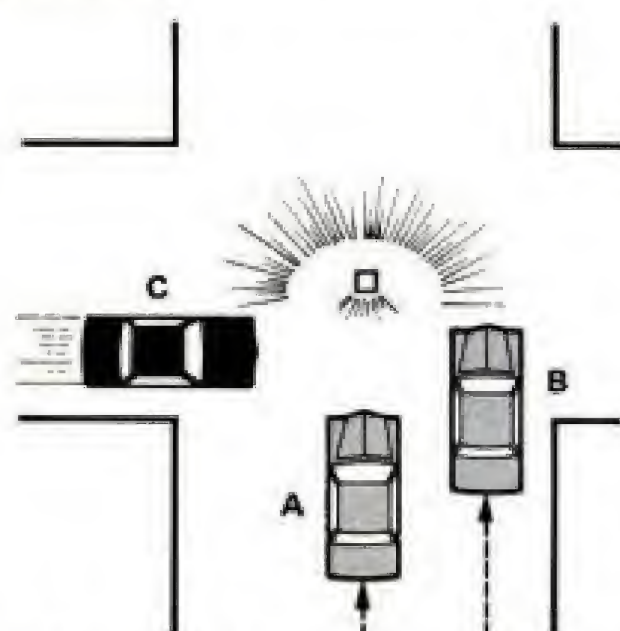
All multicar pileups are the result of excessive speed for conditions and failure to keep proper distance between cars.

The insistent tailgater might be drunk, drugged or out to kill. You have no way of knowing. Don't try outguessing or outrunning him. Get out of his way any way you can, even if it means pulling off the road; then call the police.



are buried and the injuries mended, the relevant facts are assembled and entered into the body of information called statistics.

This type of mayhem doesn't fit into the established categories of recordkeeping. It doesn't qualify as an intersection mishap, a tailgating accident; a failure to observe posted speed limits or any of the other slots on the books. It will probably be listed as *other*, with an asterisk and a footnote.



The light has just turned green for car A. Car A doesn't move because he sees C running the light. But car B, unable to see C, moves ahead and collides with C.

No society in the world can prevent this type of vehicular homicide. There is simply no way of knowing when someone's mind snaps and he takes to the road with the intent to kill. But this type of "accident" is the exception and not the rule. The

overwhelming percentage of highway accidents happen to otherwise sane people, whose only goal is to get from one place to another and who have anything but suicide or murder on their minds.

Fortunately, the more "common" types of highway accidents *can* be avoided.

For the record

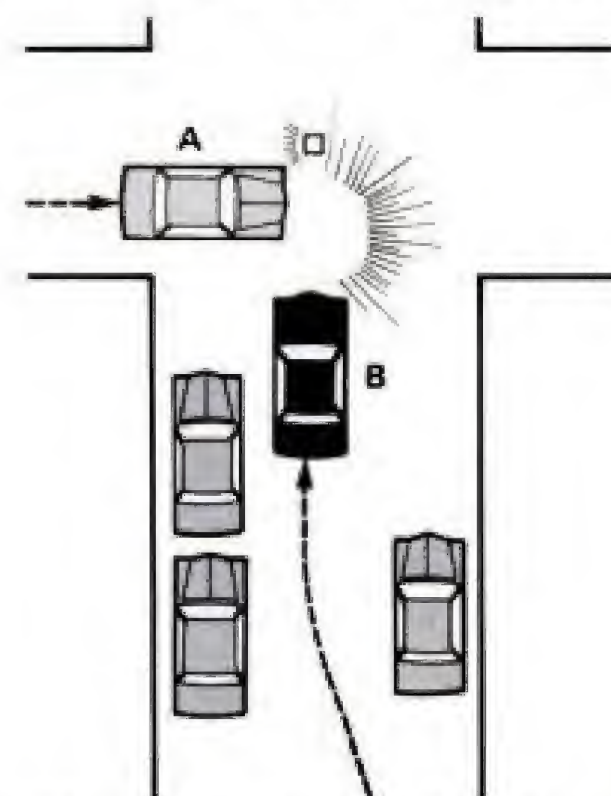
In 1979, 51,900 people were killed in auto accidents. In all, there were 26.7 million traffic accidents in 1979, one million less than in 1978. Injuries were also down by 120,000. Yet fatalities were up—400 more died in 1979 than in 1978.

It would seem to be a contradictory statistic, but there are many factors involved which lead to the increase in deaths. The reason the total number of accidents is down is that we are driving less than ever. This factor, according to the National Safety Council (NSC) and the National Highway Traffic Safety Administration (NHTSA) is a direct result of the fuel crisis. They base their information on the fact that revenues from highway tolls are down drastically. In some states, toll rates have been increased to make up for the reduced volume of traffic.

Yet, why are there more fatalities if there are fewer people on the road and fewer accidents? According to the NHTSA, the reason for the increase in fatalities is the growing population of small cars. A recent

NHTSA study indicates that fatalities in small cars outnumbered those in large cars by 8 to 1.

The most dangerous time of day to drive according to the NHTSA and NSC is between 10:00 p.m. and 2:00 a.m. The next most dangerous is between 6:00 p.m. and 10:00 p.m. The



Just because you, in car A, have the green light, don't assume the way is clear. Check either side of the intersection for someone who may be running a light.

safest time to drive is between 10:00 a.m. and 2:00 p.m., and the next safest is between 2:00 p.m. and 6:00 p.m.

The safest days to drive are Monday through Thursday. The most hazardous day is Saturday, followed closely by Sunday and Friday.



Improper passing on a two-lane road increases possibility of a head-on collision. If you're being passed improperly, and see a head-on is imminent, slow down and give the other car room to get back in the right lane. Also scan shoulder for an escape route.

You've probably surmised this from your own experience. All the "nuts" seem to be out on Saturday night.

The most dangerous type of road is a two-lane, followed closely by city streets. The safest roads are three-lane (each direction) toll roads and unpaved trails.

These three items (time of day, day of the week and road type) crop up year after year and seem to be constants. Avoiding these conditions won't guarantee that you'll never have an accident. But if you find yourself on a two-lane road at 11:00 p.m. on a Saturday night, be aware that the odds are definitely stacked against you. The ultimate value of statistics is to prevent accidents. So, if you know ahead of time

when and where you're most likely to get it, take a tip from professional gamblers and play the safest odds.

The following seven categories accounted for the overwhelming majority of traffic accidents and fatalities last year.

Speeding

One of the most debated topics when it comes to traffic safety is whether the national speed limit reduces accidents and saves lives. Unfortunately, there is no way of knowing for sure, because speeding statistics include driving too fast for conditions, which tends to cause far more accidents than simply exceeding a posted speed limit. For example, studies by the California Highway Patrol show that of the 3980 deaths occurring in that state in 1976, only 90 (2.2 percent of the total) were caused by speeding, while 584 deaths (14.6 percent) were caused by driving too fast for conditions.

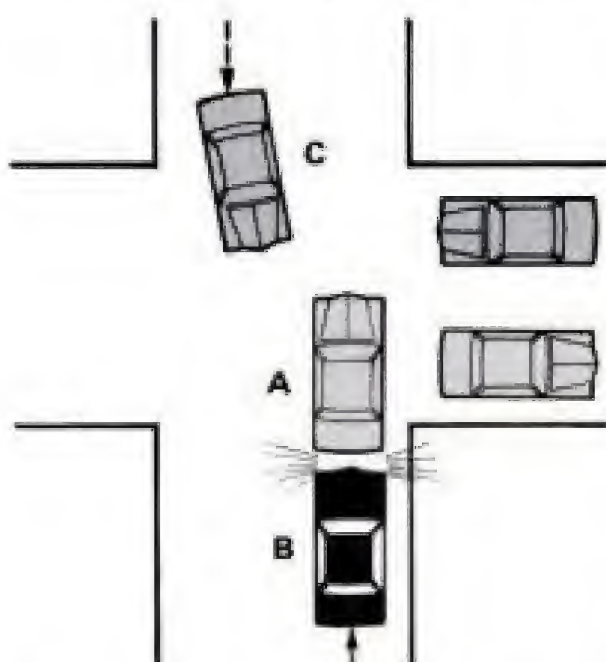
But even though there is no statistical proof that driving at 55 saves lives, there certainly is scientific proof. The National Safety Council came out with these facts:

1. If you are driving at 75 mph and get into an accident, you are likely to be hurt or even killed. The chances of being killed are one in eight.

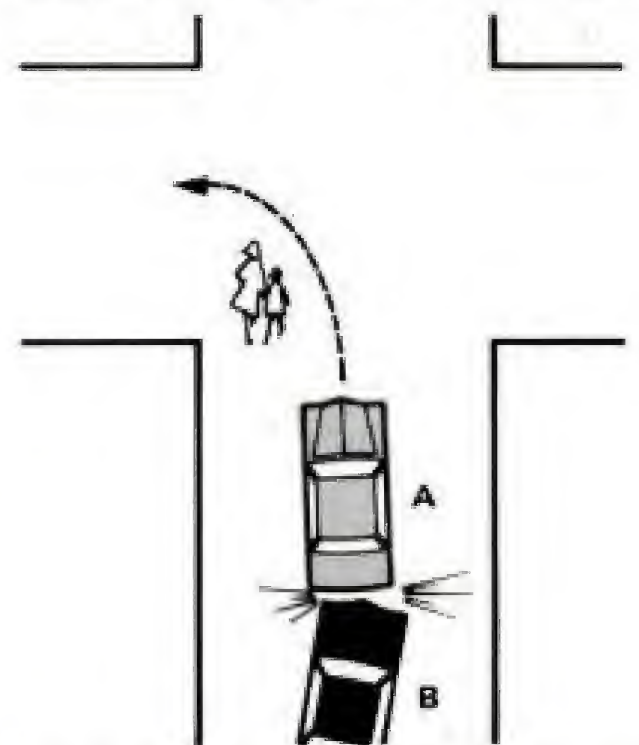
2. At 65 mph, there is a one-in-20 chance that you will die should you have an accident.

3. If you are involved in an accident at 55 mph, your chances of being killed are only one in 50.

Speeding is the largest single cause of accidents and fatalities on the nation's highways. In 1978, the last year for which complete NSC figures are available, speeding accounted for 16.9 percent of all accidents and a whopping 32.3 percent of all fatalities.



Car A enters the intersection, but brakes when C cuts him off. Car B, following too closely behind A, can't brake in time and hits A. Keep your distance at all times.



Car A moves off, sees pedestrians and brakes. Car B, not seeing the pedestrians and riding A's tail, hits his rear. Look "through" car in front to see what he sees.

ties. Over half of all fatal motorcycle accidents were a direct result of speeding, while about a third of the deaths in cars and trucks were attributed to speeding. According to the experts, these percentile figures (and the percentile figures for other types of accidents) tend to remain amazingly stable over the years—

(Please turn to page 160)

What everyone should know about

Not long ago, a team of General Electric Co. engineers prowled New York City with a sensitive radiation counter, scanning public places such as the United Nations building, Grand Central Station and even the Statue of Liberty. Those three particular structures, as it happened, proved "interestingly radioactive" to the investigators. It was so interesting, in fact, that when the Joint Committee on Atomic Energy in Washington got wind of the Grand Central Station readings, it sent an expert from the Environmental Protection Agency (EPA) to check the somewhat startling figures. That gentleman got some readings half again higher than any the GE team had recorded!

It turns out, for instance, that if you spent a year selling pencils in the vicinity of the granite wall at the redcap stand in the station's Vanderbilt Avenue arcade, you'd get a dose of radiation 24 times higher than the exposure limit from nuclear activities designated as "safe" by the EPA.

Don't panic. In the first place, you'd have to lean against that wall 24 hours a day for 365 days a year to soak it up. Few, if any, people pass close enough to it to pick up any measurable radioactivity at all. Francis Brannigan, a safety engineer for the old Atomic Energy Commission, once put it succinctly in what he called *Brannigan's Law*: "Radiation what don't hit anybody don't hurt nobody."

In the second place, Grand Central's "hot" wall isn't all that impressive to most nuclear experts, even though it may seem startling to the average citizen who is bombarded by a deluge of contradictory, often misleading and frightening information about radiation. While much is known about the effects of sudden massive doses, such as those from violent nuclear reactions, the radioactivity that drizzles around us in small amounts is quite another matter.

An aura of mystery

"Radiation," points out Adm. Hyman G. Rickover, father of the nuclear sub, "... is often described as so

Solid information on long-term effects of low doses remains elusive. But what science does know about its major sources and their effects on humans includes some surprising facts.

by Richard F. Dempewolff

dangerous that any amount is unsafe—as if the only question worth addressing is 'how fast will radiation harm you?' Because you cannot see, feel, taste, hear, or smell radiation, it has an aura of mystery...absent from other potentially hazardous things...such as radio waves, carbon monoxide and small concentrations of numerous cancer-causing substances.

These do not generate the same degree of fear as radiation."

That fear, the admiral observes, is similar to the public's fear 100 years ago when Edison's light bulb was introduced. "Wall plaques," he notes, "had to be installed in (hotel) rooms assuring people that: 'The use of electricity for lighting is in no way harmful to health, nor does it affect the soundness of sleep.'"

All of this in no way implies that *any* radiation is harmless. Scientists have known for half a century or more that it can and does cause damage to human tissue. The big question is: How much of what kind is too much?

Even in nuclear circles, the subject of low-level radiation is confusing and controversial. Several recent research studies purporting to show a relationship between low-level radiation and cancer among nuclear-facility workers, have been shot down vehemently by a majority of scientists as faulty, oversimplified and otherwise inadequate proof of anything.

The trouble is that scientists themselves haven't been able to pin down how much radiation it takes to produce a cancer. Some cancers don't show up until decades after a victim was exposed to a suspected carcinogen. And, there are dozens of delayed-action carcinogens besides radiation that may be the cause of a given cancer, either alone or in combination with each other and/or radiation.

The National Academy of Sciences Research Council, in reviewing by invitation the Department of Energy's massive, multifaceted program of research on long-term, low-dose radiation health hazards, recently concluded that the program has "cast little addi-

(Please turn to page 140)

The radiation breakdown*

Cosmic: Includes both solar radiation and that from space; 43 mrem/year, 21.2% of total.

Terrestrial background: From radioactive elements in rocks, soil, water, etc.; 57 mrem/year, 28.1% of total.

Medical technology: Highest manmade component; 90 mrem/year, 44.3% of total.

Nuclear energy production: 0.28 mrem/year, 0.14% of total.

Phosphates: From mining and use in the agricultural cycle; 5 mrem/year, 2.5% of total.

Consumer products: Contributors include glazed ceramics, dentures, watch dials, smoke detectors, TV sets; 0.03 mrem/year, 0.01% of total.

Nuclear fallout: From weapons testing worldwide; 5 to 8 mrem/year, about 4% of total.

*Average annual dosage in United States to human reproductive tissue, given in mrem per year (totals 203). Source: Inter-agency Task Force on Health Effects of Ionizing Radiation (published by the Department of Health, Education & Welfare).

Rolling along



Harley-Davidson's FLH Classic with sidecar is an \$8000, color-coordinated rolling masterpiece of sidecar chic. The bike's 80-cu.-in. engine makes the package ideal for long-range touring.

PM photo: George Ancona

Shedding its image as an eccentric's tricycle, today's sidecar offers a high-mileage alternative for commuting and touring.

by Steven Parker

What seats two, travels in excess of 100 mph and manages to squeeze almost 40 miles out of a gallon of gas? If you guessed the latest sports car, you're wrong. The product that fits this racy description is a motorcycle with an attached sidecar.

Growing in popularity worldwide as an answer to the fuel shortage, sidecars are becom-

side-by-sidecar



Equalean's flexible sidecar (top) remains parallel to the cycle when the rider leans into a turn. Sidecars are no longer only for big motorcycles. Even small-bore scooters like the Vespa (above) can carry one of the new lightweight "sidehacks," as they're now called. Depending on the sidecar's particular application, prices range from \$600 to \$2000.



Sidecars are not restricted just to carrying people. This transporter can carry a scooter, several bicycles, firewood or anything that you can tie down with a bungee cord. It's also great for shopping.

ing common sights on city streets and major highways. With gas prices going up and sidecar prices coming down, little one-wheeled appendages are once again becoming a suitable alternative to the small car.

Sidecars were originally developed during World War I for transporting messengers rapidly over virtually any type of

terrain. The high point of sidecar technology was reached years later, during World War II, with the advent of the German-built BMW sidecar. This sidecar carried a 600-cc, two-cylinder opposed engine, almost identical to that on the current BMWs, and it had a driveshaft, rather than a chain, to power the rear wheel.

The unique feature of these

Nazi buzz bombs was an axle connecting the rear wheel of the cycle to the wheel of the sidecar. In essence, it was a three-wheeled vehicle with traction on two wheels. This gave the motorcycle and sidecar combination tremendous versatility and the climbing ability of a mountain goat. While these machines were originally designed to act as



Dressing for the occasion

1 Leather pants and jackets are a must for long-range touring. They keep you warm and dry and protect in a spill.

2 Lightweight, colorful windbreakers are good even in summer.

3 Cold-weather suit protects in subzero cold.

4 Rain gear and gloves can also come in handy.



scout and messenger vehicles, the Afrika Corps soon discovered they could be used as machine-gun platforms to harass enemy troops and truck convoys.

The BMW sidecar's ability to hit hard and run fast compelled the U.S. Army to build similar vehicles. An order for 1000 sidecars was placed by the government with Harley-Davidson and the Indian Motorcycle Co. Each firm built 500 vehicles designed for the harsh environment of the North African desert and utilizing the same layout as the BMW. The Harleys went the BMW one better by having a clutch arrangement that would engage or disengage the rear axle.

By the time the sidecars were designed and built, however, the war was nearly over and the sidecars were never delivered. They languished for years in several warehouses and were eventually sold as surplus to private citizens. Needless to say, those vintage sidecars are now each worth a small fortune to collectors. At one time, they could be snatched up by the truckload for next to nothing.

Most of the sidecars sold in the United States after the war were imported European models. There was just never a demand big enough to justify a domestic sidecar industry. Also, most owners of large-bore American motorcycles considered adding a sidecar only a way of "taming" their wild machines. In Europe, on the other hand, sidecars were considered as much a part of family transportation as the automobile.

With the motorcycle boom of the 1960s and early '70s in this country, though, hundreds of thousands of Americans were suddenly the owners of bikes having engines larger than 500 cc in displacement, and they were using these motorcycles not only to ride on twisty back roads during weekends, but also to go to work and run errands. When the gas shortage hit and the American public began to look upon the motorcycle as a means of transportation, and not just fun, the sidecar was newly perceived as an alternative form of transport for goods and people.

Rigids and flexis

Today, there are three main types of sidecars which will attach easily to any medium- to large-size motorcycle. The rigid sidecar has no suspension system and is the simplest type available. Rigid models are used more for racing these days than anything else, but some purists still prefer the relatively rough ride these units provide. The most popu-



Off-road racing with a sidecar is not for the faint-hearted (above). It takes muscle and strong kidneys. Subframe for a Vespa sidecar is bolted, not welded, to the scooter (left). The sidecar is then bolted to the frame. Note the steel loop in front. It's there for crash protection. The heart of the flexi sidecar mechanism is the spring-loaded slider tube (right). It allows the sidecar to lean with the cycle.



lar type of sidecar is the sprung unit. These rigs utilize one or more shock-absorber systems on the sidecar itself, smoothing out the bumps and providing a pleasant ride comparable in comfort to that of a small sports car.

The third and most exotic type of sidecar currently produced is known as the flexi. There are only a few companies currently producing flexis, which are by far the most sophisticated of sidecar rigs.

While rigid and sprung sidecars remain upright at a 90° angle to the ground when the motorcycle is turned, flexi rigs lean at the same angle as the motorcycle. Flexis are sprung with internal shock absorbers, and many come equipped with

load-levelers controlled from the motorcycle.

Sidecar prices range from under \$600 for the simplest rigid-frame rig to over \$2000 for the most exotic and fully equipped flexi model, including convertible top, sidecar wheel brake and signal lights for braking and turning. However, there are no sidecars currently made that have a rear axle like the old WWII models. The weight of the average fiberglass sidecar is about 200 pounds, and most can be installed in about four hours with simple garage tools.

Mounting a sidecar

How you mount the sidecar will have a strong influence on how much you enjoy your rig. Sidecars

can entirely change the well-thought-out handling geometry of motorcycles, but some steps can be taken to compensate for these changes.

Most of the peculiarities of the sidecar-equipped motorcycle can be handled easily just by a bit of practice on the rig and a change in riding styles. For instance, a sidecar-equipped bike will pull to the right under acceleration and to the left

(Please turn to page 146)

New headphones for

Here they are—this year's crop of new stereo headphones. We listened and tested; now we report to you.

by Christopher Greenleaf



PIONEER
SE-405



BURWEN
PMB-8



AUDIO TECHNICA
ATH-5



PICKERING
OA-3A



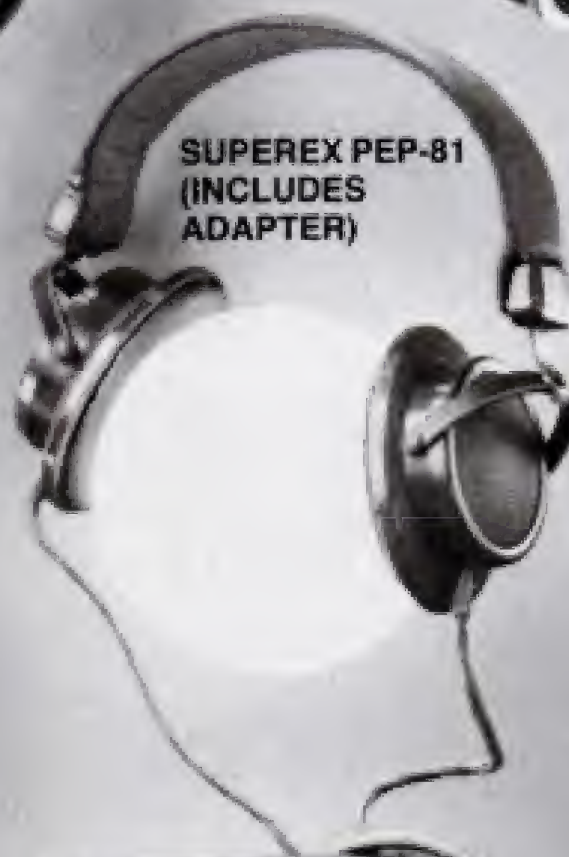
NAKAMICHI
HF-100



AKG K-340



AKG K-240



SUPEREX PEP-81
(INCLUDES
ADAPTER)



AUDIO TECHNICA
ATH-1

Buying a new set of headphones could be a bright idea this year! The text details our reviewer's response to the 'phones shown here and others as well.



every head

SENNHEISER
HD-430

SANSUI SS-40

KOSS ESP-10
(INCLUDES
ADAPTER)



When headphones are mentioned, thoughts of undisturbed privacy and intimate musical experience pop into mind. This year's offerings make headphone listening more pleasant than ever before. The 19 examples we look at here vary in list price from a mere \$27 to a hefty \$350.

Inexpensive headphones

■ AKG K-40 (\$27, open, 3¾ oz.)

This is both the lightest (3¾ oz.) and cheapest (\$27) of our lineup. Its bright, transparent sound makes it ideal where clarity is the consideration. The distinctness that each voice in music acquires through this set makes it a genuine bargain.

■ Audio Technica ATH-1 (\$30, open, 4¾ oz.)

Unless carefully adjusted, the earcups exert uncomfortable pressure on ear and head. The sound is rather intimate, a shade dry, and the amplifier's bass (or loudness) control should be used to pick up the bottom end. The sound is somewhat "toppy": The treble predominates over a less assertive mid and bass. Lightly textured music comes across quite nicely.

■ Nakamichi HF-100 (\$55, open, 11¼ oz.)

A comfortable fit permits long listening sessions. This model needs and responds adequately to bass boost. Feeding the inefficient transducers sufficient power opens up a weightless, airy sound that complements jazz and folk music nicely.

■ Pickering OA-3A (\$45, open, 7½ oz.)

Good top and healthy bass straddle a slight boxiness in the mid-range, but that is correctible if you have appropriate equalization available. Harpsichord and guitar are pleasing with this set.

■ Pioneer SE-405 (\$55, sealed, 17 oz.)

Like many other 'phones, this set can use some bass added by the amp's tone controls. Though comfortable on the ears, this headphone is large and a bit cumbersome. A convenient 16½-foot cable and volume knobs on each earpiece enable this model to be more independent from the amplifier than most.

■ Sennheiser HD-400 (\$44, open, 4 oz.)

Shallow bass and ethereal middle region improved by bass and (if you have it) mid-range EQing (equalizing). Experimentation with proper ear pressure helps, too. Firm, piping treble is excellent and solid and a fine balance with the adjusted bass is possible. Comfortable to wear, the HD-400 is recommended for all but the most bass-heavy music.

Mid-priced headphones

■ AKG K-240 (\$85, open, 9¾ oz.)

The top of its class, the K-240 is a durable, comfortable and rich-sounding open headphone. Wonderfully roomy sound is helped by large vinyl rings fitting around (not on) the ears. The bright treble can be mellowed by slight equalizing. Radical acoustic design and transducer engineering make this a genuine bargain.

■ Audio Technica ATH-5 (\$80, open, 7¼ oz.)

The ATH-5 is a comfortable headset with a lithe sound. The sound is slightly unfocused, which works well in "taming" over-recorded or unbalanced stereo sound. The lack of definition makes some classical and brightly recorded music a bit too homogenized, but it's still listenable.

■ Beyer DT-441 (\$75, open, 10 oz.)

A bright, almost wispy sound in a comfortable package, the DT-441 needs and responds nicely to bass augmentation. The mid is a little underemphasized and can make sonic spectacles very impressive, but needs careful equalization to satisfactorily reproduce the hu-

(Please turn to page 158)

"Not nearly the quality you'd expect in a car that costs \$15,000," moaned a New York insurance broker, and he's far from alone in panning the 1980 Corvette's paint job and overall finish.

A number of owners told us that their cars had to be repainted before they took delivery—some two and three times!

"I work in a body shop," testified a Michigan bodyman, "and I'd like to show General Motors how to paint a car!"

An Ohio construction electrician volunteered: "The dealer not only repainted my entire car, he then replaced the console, headliner, windshield and mirrors—all because of poor quality."

A Michigan housewife urged that, "... Chevrolet should fire the Corvette paint department supervisor."

And a Chevrolet reliability engineer, who happened to be among the 1000



Rear spoiler was added in 1980 to improve aerodynamics and freshen appearance.

PM OWNERS REPORT: CHEVROLET CORVETTE

Corvette owners we interviewed, put it bluntly: "Workmanship rates average by American standards, poor by foreign standards; it should be better on a \$15,000 car."

A Michigan real estate agent summed it up pretty well when he said, "You'd think after 12 years with the same body they'd finally get it right, but obviously they haven't."

Despite all those salvos and many more like them, Corvette owners love their cars, and a healthy 87.6 percent swore they'd buy another. Nothing seems to dampen their enthusiasm—surely not a little ripply fiberglass and shoddy paint.

"I'm still in love with the car," confessed a Tennessee disc jockey. "I've owned six

Vettes and still own the 1970 model I bought new."

An Ohio sheet-metal worker seconded, "I've had 23 other Corvettes, and this latest one won't be my last. Once Vettes get in your blood, you don't get them out that easily."

A New Mexico sales rep: "Even though Corvettes have been on the market so many years, they still constantly attract attention. I've owned four, and it's been that way with every one."

An Ohio machinist, aged 22: "I drive a Corvette to stand out in the crowd. My girlfriend's mother says I'm arrogant. She's probably right."



Standard 305-cu.-in. V8 yields adequate performance and 17.4 mpg on the highway.

Another automotive engineer from Michigan wrote that he bought his Corvette for, "Sex appeal. Overall, I knew what I was getting into, so I'm not disappointed, but the paint job is unbelievable,

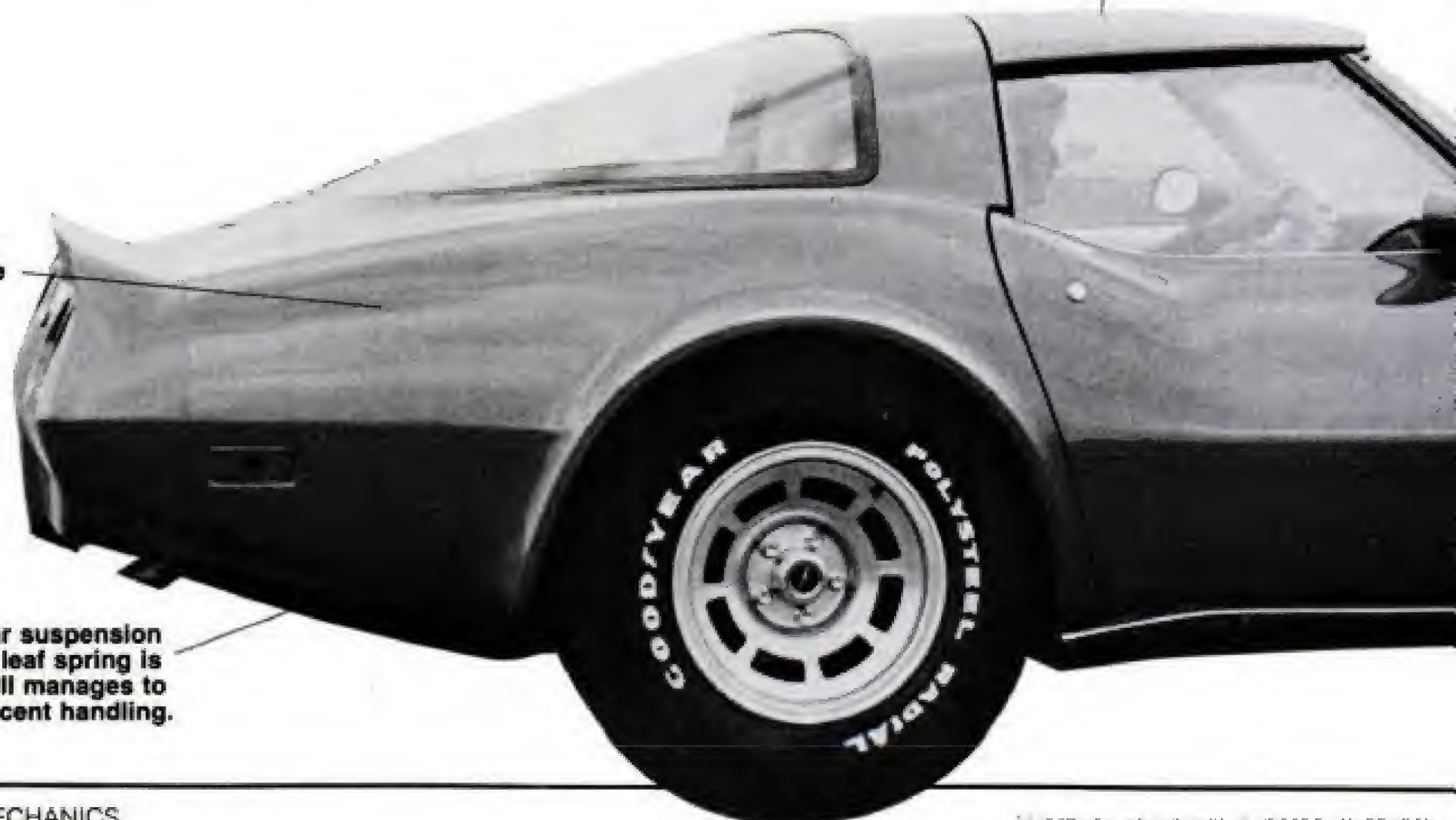
BY MICHAEL LAMM WEST COAST EDITOR

Poor workmanship and a bad paint job can't quench Corvette fever

For topless motoring, roof hatches are optional. Some owners want convertible top.

Owners' loudest complaint was the poor quality of the paint job.

Independent rear suspension with transverse leaf spring is outdated, but still manages to give the Vette decent handling.



and there are numerous waves in the fiberglass."

Corvette owners undoubtedly tend to be pickier, too, than people who buy less visible and less expensive cars. We last surveyed Vette owners in 1977, and when we compare figures, there's no doubt that workmanship and finish have taken a nose dive. In 1977, 41.1 percent of our respondents rated overall workmanship *good to excellent*. This year it's only 35.1 percent. Also, in 1977 only (only?) 19.9 percent put down *workmanship* as a specific dislike. For 1980, that figure stands at 32.3 percent.

A Texas drug retailer capsulized it in these words: "This is my seventh Corvette since 1974, and every year it seems that the quality of workmanship has gone down."

For many owners, especially those who'd just bought their first one, the Corvette fulfilled a lifelong dream. "I've wanted one since I was a kid," confided a Texas pharmacist. "It's the American sports car."

A Michigan senior auditor echoed: "I like the sports-car image. I'd wanted a new one for five years and eventually saved up the money. I'm not interested in a foreign sports car because of the state of our domestic economy."

"It's just a fun car to drive," stated an Illinois salesman, and he had plenty of company in that sentiment.

A sizable number of owners also mentioned the Corvette's good resale value as a buying goad. "Same as buying a blue-chip stock," commented a Kentucky farmer, and a Texas loan officer concurred. "I've owned four Corvettes," said the Texan, "and they've all been real good investments. You can't beat a Corvette when it comes time to sell."

However, this same loan officer pointed out another side of the coin. "The main problem of owning a Corvette," he volunteered, "is trying to get insurance. If there's any type of blemish on your driving record, and if you're unmarried, then

(Please turn to page 186)



Removable twin roof hatches are options. Rear-deck hatch carrier is also optional.

A Vette vignette

The current Corvette's fiberglass body made its debut in 1968. America's only sports car shed 250 pounds for 1980 through a regimen of trimming the panel thickness in doors, roof and hood; by lightening certain chassis members; by casting the intake manifold and differential housing in aluminum, and by slimming down all glass. Even so, the Vette still weighs 3520 pounds.

This year's V8s are the L-82 305 at 145 hp net and the L-48 350 at 170 hp. You can get a four-speed outside California, but in the Golden State Turbo Hydro with a lockup high gear is it.

Full list of options

As the Corvette lost its 427 and 454 V8s, the list of standard equipment was expanded to compensate. Currently the Vette's \$15,000 price tag includes airconditioning, power windows, power steering, vacuum-assisted four-wheel disc brakes, tilt wheel, AM/FM radio, burglar alarm, hatch roof, twin remote outside mirrors and P225/70R-15 steel-belted radials on 15x8 wheels.

There's also a plastic storage rack that plugs into holes in the rear deck. This rack is designed to carry the removable T-top panels.

Rumor has it that a totally redesigned Corvette is due out in mid-1982 as an '83 model.

It will again use the front-engine/rear-drive configuration, but will be smaller, lighter and perhaps a bit more agile. It will still use a fiberglass body and will most likely offer a choice of a turbocharged V8 or V6.

A NATIONWIDE SURVEY BASED ON 808,546 OWNER-DRIVEN MILES

All body panels are thinner to cut weight and improve mileage.

The standard engine is the 305-cu.-in. V8, optional is the 350-cu.-in. V8. Mileage difference between them is negligible.



The new nose style, introduced in 1980, aids aerodynamic downforce and also cools the radiator more efficiently than older design. The interior (right) sports newly designed bucket seats which got high marks from most owners.



Four-wheel disc brakes are standard and pack tremendous stopping power.

PM photos: John W. Lamm

Muscle mills like this 235-hp motor, Evinrude's largest, have the torque to pull a slalom skier, but can also throttle back to a slow cruise that burns minimum fuel.



Smallest in the new Chrysler line, the 3.5-hp Economate is loop-charged, water-cooled and weighs 32 pounds.

Light rig to match compact car: Johnson's 25-hp model gives runabout planing-speed performance, fuel economy.



'81 outboards for economy boating

Next year's outboard motors are going to be better without getting bigger. Though it's no secret that even larger muscle machines are hidden away in manufacturers' research labs, these 300-plus-hp kickers are not likely to be afloat next spring. Emphasis right now is on mid-rangers—the mills that can pull skiers up from a deep-water start or skim out to a favorite fishing spot, but that also throttle back to an economical troll or cruising speed.

A large engine, throttled down, will burn less gas than a smaller rig roaring along full bore to provide equivalent speed. And for running home ahead of a storm or fighting a strong current, the big engine makes sense.

Manufacturers with full motor lines, ranging from more than 150 hp down to the mini-models, introduce their new outboards in the fall. Makers of motors for small craft and fishing will be showing their innovations next spring. Major big-mill makers are Chrysler, Evinrude, Johnson and Mercury.

Mercury still holds the lead in potent powerplants with its 300-hp unit. Stretched between this and the little 3.6 are 16 additional categories. These include 4, 4.5,

Lighter and more refined engines are now providing more push from less gas.

by Bill McKeown
BOATING EDITOR

Fishermen want power to reach distant fishing flats fast. New Johnson 70 has Easy Tilt manual trim for thin water.



7.5 and 9.8 (with special, optional propellers for sailboat auxiliary use) and 18 and 25. The 7.5 through 25 come with manual or electric start factory-installed. A do-it-yourself kit adds electric start for the Merc 18 and 25. Little three-pound battery packs can be fitted under the cowls of the 7.5 and 9.8 to provide electric start without a heavy external battery. A 4.5-amp., 60-watt alternator keeps the pack charged. An optional, short tiller control helps these two fit well in a sailboat outboard. Larger Mercurys of 40, 50, 70, 80, 90, 115, 175, 200 and 225 hp give a wide choice to match the requirements of various hulls.

Smaller engines get boost

Johnson and Evinrude will be moving some of the refinements of their largest engines down into the smaller models, with more speed and less fuel consumption as bonus results. This year's 85-hp will have refinements that increase it to a 90. And exhaust tuning, a new, lower-drag gear case, new gear ratio and additional improvements make the 35 a new lightweight 1981 motor. Even the Evinrude and Johnson 15s will be using tuned exhausts. A gain of 23 percent in speed and a saving

(Please turn to page 150)



Refined from present 35-hp model, Evinrude experimental prototype (above) previews development mill.

Mercury's 25, with manual or electric start, can be clamped on an inflatable. Electric start can be added from a kit.

The appearance of Datsun's freshly restyled 200SX was this car's best- and least-liked feature. On the plus side, the new styling attracted the overwhelming majority—a whopping 80 percent—of the 200SX buyers who participated in our owners report. Yet the shape of the car's body, particularly in its hatchback form, also caused the most groans. The rear compartment's tight seating came in for severe censure from a number of our respondents.

A New York contractor, for example, told us, "Who's kidding whom? This is a two-passenger car."

A Nebraska student said, "One rear passenger might be okay, but two get pretty cramped."

A California financial analyst pointed out: "The car looks good, but if rear-seat



Comely 200SX competes with other styling stars like Celica, Challenger and Scirocco.

PM OWNERS REPORT DATSUN 200SX

riders could sit up taller (which they can't), the legroom would be much improved. A redesign of the rear compartment, especially one with a slight raising of the roofline, would provide much more seating space."

Not to belabor the point, many of the owners who bought the 200SX were aware of its abbreviated rear seat. "It is, after all, a 2+2; so rear-passenger comfort wasn't a big consideration when I bought the car," commented a California consultant.

And a Mississippi photographer summed it up for many owners when he wrote, "I bought this car with no intention of having anyone sit in the back seat." He, along with 55.4 percent of his peers, had no children.

Front-seat comfort came in for great praise, with 96.0 percent of our respondents judging it *good to excellent*. "For two people on a long trip, the 200SX is the most comfortable car I've ever been in," enthused a Tennessee data clerk.

A California real estate broker told us, "I'm 6-4 and my wife is 5-2, and both of us love driving this car. The seat moves back and forth to suit us both."

We heard a few grumbles about seat shape and shoulder-harness discomfort, but we hear similar remarks about every car.

People said all sorts of good things about the Datsun 200SX fuel mileage. "The mpg is fantastic," exulted a New York student, "not only in itself but also in relation to engine performance. For a four-cylinder car, this one really cooks!"



Comfortable front seats face fully instrumented panel; SL has eight-way buckets.

BY MICHAEL LAMM WEST COAST EDITOR

Appearance pleases while the back seat squeezes

Spunk and economy of 100-hp, fuel-injected ohc Four pleases owners.

Suspension provides a compromise between firm, sporty feel and gentle ride.

Options include power steering and aluminum 5½Jx14 wheels.

New 1980 model snares no sheet metal with previous 200SX Datsuns.



An Alabama plant manager expressed the same opinion: "A powerful, fuel-efficient, smooth engine."

A West Virginia trust officer added, "I drive 25 miles a day to and from work. So I need an economical car. I keep close track of my mileage. With the overdrive five-speed, I presently average 31.3 mpg in town and 38.7 on the highway."

Those figures, while easily attainable, topped the national average by about 3 mpg. Our survey—and we consider it far more accurate than the Environmental Protection Agency (EPA) estimates—posted 28.2/36.0 (city/highway) for the five-speed and 24.9/31.0 for the automatic.

Part of the mileage story has to do with Datsun's use of the Bosch L-Jetronic fuel-injection system in the 200SX. A California analyst wasn't alone when he told us, "I'm very pleased with the fuel injection. The car starts and runs well right off, even on cold mornings. I consider this not only a convenience and mpg boost but also a safety feature."

Speaking of safety, a Tennessee technician disclosed that, "... I totaled my first 200SX and came out without a scratch. It's a solid car. Immediately after the insurance company paid off my wreck, I went right out and bought an identical car. So you know I'm a satisfied owner!"

Ride and handling also came in for solid praise from 200SX owners. A Tennes-

see rental agent observed, "It drives like a sports car, really hugs the road." A North Carolina Navy corpsman seconded, "It rides better than the Dodge Magnum I traded in."

An Oregon dairy milker: "Good handling in sharp corners; smooth and responsive."

A Minnesota transportation engineer: "It's a very quick car with the five-speed, handles nicely on the road, and is very comfortable for two people."

Generally speaking, owners of five-speed models seemed happier with their cars' responsiveness and engine performance than those who had opted for the automatic. Some of the automatic pilots would have liked more horsepower. The five-speed shift mechanism, though,

(Please turn to page 168)



Gone is the old model's thick C-pillar; the new 200SX has 11 percent more glass.

Datsun's sexy new 200SX

Datsun introduced its first 200SX in 1977. The restyled, re-engineered 1980 version shares only the designation.

The 1980 200SX comes in two body styles and two trim levels: hatchback, notchback, Deluxe (standard) and SL (Sport Luxury). The SL includes AM/FM stereo with four speakers and joystick control, digital clock, rear wiper/washer, diagnostic display, variable-speed front wipers, eight-way driver's seat with lumbar and thigh-support adjustments, plus upgraded fabrics, colors and trim.

Full list of standards

All 200SXs come with such standard features as four-wheel disc brakes, five-speed overdrive transmission, reclining seats, split rear bench in hatchbacks, rear defroster, full instrumentation, tach, quartz clock, chimes, motorized outside mirror, remote deck release, console and much more.

Engine is the 1952-cc Z20E ohc Four with fuel injection and the NAPS-Z smog system. It delivers 100 hp and uses two sparkplugs per cylinder in its California version.

The four-wheel disc brakes are similar in size and operation to those of the 280-ZX, with 9.98-inch front rotors and 10.59-inch rotors in the rear.

Front suspension is by MacPherson struts, with a four-link coil setup around back and antiroll bars at both ends.

Among the 200SX options available are a sunroof, cruise control, airconditioning, aluminum wheels, automatic transmission and power steering.

A NATIONWIDE SURVEY BASED ON 2,174,002 OWNER-DRIVEN MILES



Low roof and tight legroom render 200SX a 2+2. Rear seat is mostly for children.

Electric hatch release complements rear glass defroster—both standard.

PM photos: Robert J. Lamm

Four-wheel disc brakes impressed some owners as mushy and slow to react.

Smooth, peppy ohc Four delivers 28/36 mpg with the standard five-speed, according to our survey. Hatchback's split-fold rear seats give up to 25 cu. ft. of cargo volume. The coupe's shallow trunk has only 8 cu. ft., but keeps items out of sight.





How to get more heat from a space heater

Whether you choose a wood stove or kerosene heater to supplement your central heating system, follow these guidelines for operating it efficiently.

by John Ingersoll

A properly made fire maximizes net B.T.U. gain, minimizes creosote buildup in chimney.

For whatever reason you invested in a space heater, you're now a member of a sizable energy-saving group of converts who want to conserve central heat.

"Why spend good money to keep a bedroom used from 11:00 p.m. to 7:00 a.m. at a constant 68° F.?" asks one Columbus, Ind., space-heating enthusiast.

Why indeed? Space heaters, used judiciously, can save you cash. The key words are "used judiciously."

For example, it makes little sense to get off oil- or gas-fired central heat, only to pour out hard cash for cord after cord of split logs to feed a voracious wood stove.

The common-sense principle of using a space heater to advantage is a matter of good timing. Quite simply, rooms not used for several hours during the day or night need not be heated to 68° F., as do areas of the home in constant use. Prime examples are upstairs bedrooms and

bathrooms during the day. At night, while the family is asleep, the living room, kitchen, dining room and downstairs lavatory can be kept at 62° F., or less.

Space heaters have the additional bonus of being useful in an emergency. If your furnace gives out in the middle of a blustery December night, space heaters can save much grief. They are also handy for occasional demands, like heating a workshop or garage.

Avoid these hazardous practices



Never dry green or storm-soaked logs (or garments) on top of a wood stove. Such items can reach their flash point quickly.



Do not burn trash of any kind in your wood stove, especially plastic-coated cartons. Use your old newspaper only for kindling.



Chemical fire starters are not safe for use and aren't good for the stove, either. The quick temperature rise may warp firebox.

Photos courtesy of Washington Stove Works

Space heaters used as zone heaters give you the option to save money. The rest is up to you. Here's a roundup of tips to gain maximum heat for the least investment:

Heating with wood stoves

The picture series at right illustrates steps to take when breaking in a new wood stove. An airtight stove was used for the series, but the principles apply, with minor variations, to Franklins, potbellies and air-circulating stoves.

Information that manuals often don't include was gathered from industry researchers and veteran wood-stove users.

All the people I spoke to agreed that the toughest technique to learn is balancing air and fuel to (1) get a good burn, (2) use the least amount of fuel and (3) avoid depositing excessive creosote in the stove and flue.

"The most convenient, most efficient money-saving fire is one in a stove with a full charge of wood starved for air," says researcher John Allen of Battelle Memorial Labs, Columbus, Ohio. "That's also the way to produce a lot of creosote."

The straightforward way to avoid creosote (a chimney-fire risk) is to open the damper, give your fire plenty of air and allow it to burn briskly.

A hot fire tends to burn off creosote before it swirls up the flue with smoke. Second, the high heat warms the flue lining to a temperature at which creosote fails to condense.

But—and it's a big but—the fast-burn method runs up your wood-supply bill.

Are there solutions? Yes. Wendell Stickney recommends a bed of ashes in which you bury live coals through the night (see *The Art of Burning Wood to Get More Heat*, page 122, Sept. '80).

This approach is also recommended by Allen and Dr. Jay Shelton, co-author of *The Woodburner's Encyclopedia*.

"Let the wood charge burn to charcoal before you retire at night," says Allen, "and bury live coals in ashes; then shut down the damper completely. Some carbon monoxide (CO) will escape up the flue, but no bad hydrocarbons and almost no creosote."

When you arise in the morning, enough live coals will remain to fire up a small load of kindling. Then, on go fresh logs and, by adjusting the damper for a good burn, heat will come up rapidly.

A second procedure leads up to the same morning routine, but delivers

How to break in a new stove



Open damper on stove completely. Also, open all the windows and doors in the room to ventilate fumes and smoke from paint, oil and sealants on a factory-fresh stove.



Do not start your first fire on a bare, metal stove bottom. Be sure to lay down 1½ in. of sand or cold ashes before adding kindling in the front area of the stove's firebox.



Ignite kindling and allow it to burn for about 60 seconds with door closed before adding three or four small logs. Partly close the damper and wait until small logs catch and glowing embers form. Then add larger logs.

more heat through the night. Load the stove with one or two large split logs. "Large" means large in relation to the firebox size, a judgment you can make easily. Turn down the damper, but don't close it. How far down you shut off air is something you'll learn by trial and error.

The idea: Large logs will burn more slowly than smaller pieces, but with some air intake in the firebox, they will *burn*, rather than smolder. Burning logs produce less creosote and at the same time warm the stove and, consequently, the room.

This tactic will produce some creosote. (All burns produce *some* creosote.) Old-timers believe that a quick, hot fire in the morning every day will consume most of the creosote that settled out the night before. Caution: Build a small, hot fire, not a big, hot fire.

Here's more advice on space heat-



Adjust air intake to achieve steady, moderate flames. Too slow a fire will build up creosote and lots of ash. Using a shovel and scuttle, remove all but 1 or 2 in. of ash when it hampers the fire-making.

ers directly from the professionals: ■ Hairline cracks in the stove metal or paint bubbles on the outer surface are a clear sign you're overfiring. Overfiring also accelerates corrosion of the stove's inside parts, whether steel or cast iron. The proper solution is to build smaller fires.

■ Dampers control the combustion air—and consequently the fire—on an airtight or circulator stove or wood furnace. There is only one way to control a fire in a Franklin, potbelly or any leaky stove: Limit the fuel.

■ Flashback—the instantaneous burst of flame from the firebox when a wood-stove door is opened—can be extremely dangerous. It happens when you open the door of an airtight stove or furnace that is totally damped down and in which a slow fire has been burning for hours. Atmospheric oxygen rushes in, ignites

unburned gases, and flames leap toward the source of the oxygen—outside the stove door.

Anyone in the path of that fiery blast will be burned. Prevention is relatively simple: You just open the

damper and leave it open for 20 to 30 seconds before you swing open the stove door (slowly).

■ Stoves with a grate, such as a Franklin, coal stove or solid-fuel furnace, need an air space between

ashes and the metal grate. Hot embers in the ashes can cause the grate to rust, warp and break.

■ Invest in a Class A fire extinguisher and/or keep a bucket of sand close by a wood stove. Only *after*

Timely maintenance keeps stoves and space heaters in top shape



Creosote buildup in the stove acts as an insulator and quickly reduces its efficiency.

Every zone heater requires maintenance; no system works flawlessly forever. Solid-fuel burners call for upkeep on a steady basis. Other space heaters require less. Here's the run-down for each:

Wood and coal stoves

Getting rid of creosote wins top priority on your maintenance list for fireplace inserts and wood and coal stoves. When a stove's operation is ideal—hot fire, proper installation, insulated flue—only small deposits of creosote may collect. Owners of such stoves could get by with perhaps one chimney cleanout a year. But when conditions are bad, creosote can block a stovepipe opening completely in less than seven days of continuous fires. In its hardened or crusty state, creosote is flammable and the cause of many chimney fires.

A personal inspection is the best insurance against a chimney fire caused by creosote buildup. With the stove fire completely out, remove the stove-pipe connector, shine a light up the flue into the stove and check visually.

The cleanest, most convenient way to rid a system of creosote is by phone. Call in a professional chimney sweep and pay between \$50 and \$100 to have it done. (Pros charge the fee for each flue cleaned, not by the chimney structure.) If you want to do the job yourself, the tools you'll need include a steel-wire flue brush and extension rods, and a

long-handled firebox brush. These will cost between \$45 and \$75. Other good aids include a shop vacuum, trouble light with long cord, shovel and metal pail (See *Sweep Your Flues Clean and Avoid Costly Chimney fires*, page 110, Jan. '80).

How about tossing proprietary chemicals into the fire as a means of dispersing the creosote? Most pros agree that the chemicals help, but they disagree on how much. Some pros are concerned about the long-term corrosive effect of chemicals on metal and masonry joints. Don't try the Colonial-times trick of throwing salt on the fire. With moisture and heat, salt produces minute quantities of hydrochloric acid—a definite metal eater.

Here are a few more pointers:

- A hairline crack in cast iron will become a break. Welding is only a temporary solution; it's better to order a new part.
- A cracked seam on a steel stove can be welded, provided plates are not warped.
- Repaint or touch up a stove exterior with auto-engine paint having a heat tolerance of 1200° F.
- Stove smoke drifting into the room indicates poor draft. The trouble can stem from one or more of the following: (1) a clogged stovepipe or flue; (2) a stovepipe jutting too far into the flue; (3) too many elbows in the stove connector; (4) too little room air; (5) a flue under-

sized for the stove; or (6) high evergreen branches producing a downdraft in the flue.

If the solution doesn't show up readily, it would be best to seek help from the stove dealer.

Gas-fired space heaters

Before starting up a gas heater each fall, remove the heater casing and vacuum the inside. A house vacuum is adequate. Use the upholstery-cleaning attachment to reach and clean any dusty crevices.

Electric space heaters

Vacuum-clean an electric heater in the same way as a gas unit. Do it a couple of times during the heating season, too. "Baked" dust is what discolors wall paint or wall covering around an electric zone heater.

Oil-fired space heaters

Carbon deposits will collect around an oil burner and may impede the flow of fuel if the carbon isn't cleaned or knocked out. Some burners have a cleanout device that loosens the car-



Remove electric baseboard heater cover and clean out dust with a vacuum at beginning of, twice during, heating season.

bon, which then is consumed in the flame. Pump the cleanout once a day. Also, it's wise to check the flue once a year for accumulated carbon. Clean it as you would clean a fireplace or stove flue.

Portable kerosene heater

Clean the wick and flame spreader when you see carbon buildup in a kerosene heater. The easiest method is a dry cloth followed by a thorough vacuuming.

sand and chemical are spent, should you ever douse a red-hot stove with water. Instantly, water will turn to scalding-hot steam and may crack a cast-iron firebox.

■ Be certain to install a smoke alarm in the space heated by your wood stove.

Using a coal stove

Burn the size coal for which your stove was intended. The manufacturer will specify pea, nut, stove or egg-size pieces. In general, the smaller the firebox, the smaller the coal size. Most grates are too open for pea coal, and large chunks leave clinkers that are inconvenient to remove.

Before starting a coal fire, open doors and slightly crack a window or two. You want plenty of combustion air, since coal produces considerable CO before it settles down to a slow burn. (This problem rules out a coal stove for use in a mobile home.) A good draft in the stack, plenty of room air and an open draft regulator send the initial release of CO up the flue.

With the draft slide open, start a coal fire with paper and dry kindling, just as you would a wood fire. When the flames peak, add a small charge of coal. Let it catch fully; then add more coal, but never an amount mounded higher than the firebrick lining. Once the charge has caught, close the draft regulator.

To recharge the stove, as you would for an overnight burn, shake the grate until a few red-hot coals drop down. Open the ash door—but slowly—to establish a draft, or you may get a puff of smoke billowing into the room.

Leave the door open until the coals fire up glowing red. Then add the new charge and close the ash door and the draft regulator.

Figure on emptying the ash drawer once a day and keep at least two ash cans handy for this purpose.

Does coal save cash? Often it is less expensive than many other fuels. But there's a catch; some communities don't permit coal-burners. Check before you buy and burn.

You can save money operating a coal-burner by letting the fire burn out during the day and relighting it the next morning. It's more maintenance work, but you do save money.

Electric zone heaters

Electric heaters are pretty easy to operate: Flip the switch, and you have instant heat where you need it. There are, however, a few rules.

■ Don't place furniture in front of the heater, especially a radiant unit.



Inflated bladder, inserted in flue, serves as form for cement-lining mixture.



Cement mixture is pumped between bladder and interior wall of chimney.

New flue lining for old chimneys

An old, unlined, poorly insulated chimney encourages creosote deposits. Until now, you had two corrective choices: Tear down and rebuild the chimney, or insert a stainless-steel liner. The first option could cost as much as \$3000; the second solves part of the problem, but the liner starts to corrode after three to four years.

Supafu, a system of injecting insu-

lating masonry between the chimney inside and an inflated tube, has proved itself in England for up to 15 years. In addition to closing joint gaps and insulating the chimney, a poured flue tends to strengthen the total chimney structure. Installation cost is around \$600. For more data, write to National Supafu Systems, Box 640, Cobleskill, N.Y. 12043.

You might end up with a charred chair, or worse.

■ Drapery material must be able to withstand 200° F. to hang over a baseboard heater. Check this out with the fabric manufacturer or dealer when buying drapes.

■ Never hang wet clothes over an electric heater. This is a fire hazard.

Gas zone heaters

The same rules apply to gas heaters as for electric. They have the same easy startup. Although unvented gas heaters labeled by the American Gas Assn. (AGA) are safe for indoor use, you'd still be wise to open a door to other spaces in the house, or crack a window slightly.

Oil-fired zone heaters

Most oil heaters are rated for No. 1 oil or kerosene, generally stored in a raised tank outside the house. Units are also available with attached tanks, but these need refilling daily.

Portable kerosene heaters

Ordinarily put into use for emergency heat, all kerosene space heat-

ers must be fueled by hand to operate. As you would for an unvented gas heater, make certain the space in which the heater is located has plenty of fresh air.

The advantage of built-in oil, gas or electric heaters is wrapped up in the switch or starter—something coal and wood stoves lack. There are a lot more man-hours involved in running a wood stove for supplementary heat than in using an electric heater. Not only is an electric heater far more convenient, but you can easily control the hours of heat as opposed to those hours when no heat is needed. It is very easy to overfire a wood or coal stove and have more heat than you know what to do with.

In terms of cost per B.T.U., coal and gas space heaters are the cheapest to run. Electric heaters are generally the most expensive, but at least you don't have to refill them.

Of course, comparisons fall apart when you match wood you chop yourself against the price of electricity, oil, coal and gas.

Which course you take to supplement your central heating, and how much you save, is up to you. **FM**



Every stationary tool in this elegant setup has been fine-tuned by its owner — to deliver super performance.

This master craftsman's dream shop is in a log cabin

by Harry Wicks
HOME AND SHOP EDITOR

John Opfer Jr. lives in a workshop world that most home craftsmen dream about. Located in a separate building convenient to his home, the workshop gives him "all the space that I ever wished for." When John and his wife, Mary, moved to the north woods of Michigan eight years ago, the plans for his new workshop were as important to him as the building of the house proper. The two were built simultaneously.

The house and shop, as well as the garage, are built in the log-cabin motif. Originally an excavation contractor in Ohio, Opfer acted as his own general contractor to build his home in Michigan. His "spread" nestles comfortably in the cool woods atop a high bluff overlooking Lake Michigan. This enchanting setting is the backdrop for shop No. 12 in *Popular Mechanics'* Great Shop Series.

The first thing that strikes a vis-

itor to this shop is the color of all the stationary power tools. Regardless of make, all are the same metallic blue. The inevitable question "Why the color switch?" brought a relevant reply.

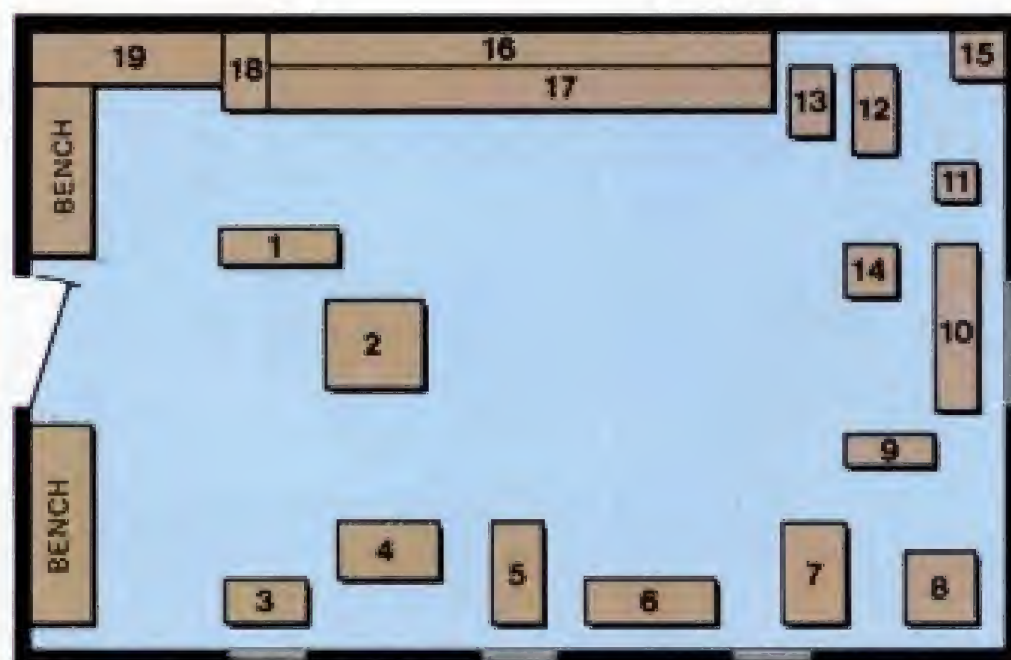
"As soon as I unpack a newly purchased tool," Opfer says, "I put it through its paces. I am particularly concerned with how smooth a tool runs and, if I think I can make it run smoother by doing a little customizing, I do."



Shop's neatness belies the fact that its owner is a superactive workshopper. At left, shop viewed from the front door; above, the view of the opposite wall of the building. It's all in the log building shown at top. The shop's owner, a fine craftsman and machinist, has practically rebuilt all equipment in his shop.



PM's home and shop editor (left) and Opfer discuss the many fine projects that were created in this shopful of precision tools.



SHOP FLOOR PLAN

1. Swedish workbench
2. Table saw
3. Planer
4. Jointer
5. Bandsaw
6. Uniplane
7. Shaper
8. Grinder
9. Belt and disc sander

10. Wood lathe
11. Sander/grinder
12. Floor drill press
13. Bench drill press
14. Cabinet for drill-press accessories
15. Shop heater
16. Wall cabinet/tools
17. Large workbench/tools below
18. Screw storage cabinet
19. Small materials storage



Two cabinets, picked at random, emphasize this shop owner's neatness. At left, various carpenter tools are hung so they can be located quickly. Below, handsaws and chisels take up a cabinet of their own. Both of these are in cabinet No. 16 on floor plan.



He notes that he always re-mounts the motors on Styrofoam (for quieter running), installs new custom-turned pulleys and replaces the V-belt with a Polyflex belt.

When he feels that the tool is ready for duty, he says with a wink, he gives it a spray coat of "Opfer blue." To do it, he uses an automotive spray paint.

The next step is to build a custom cabinet to mount the tool on.

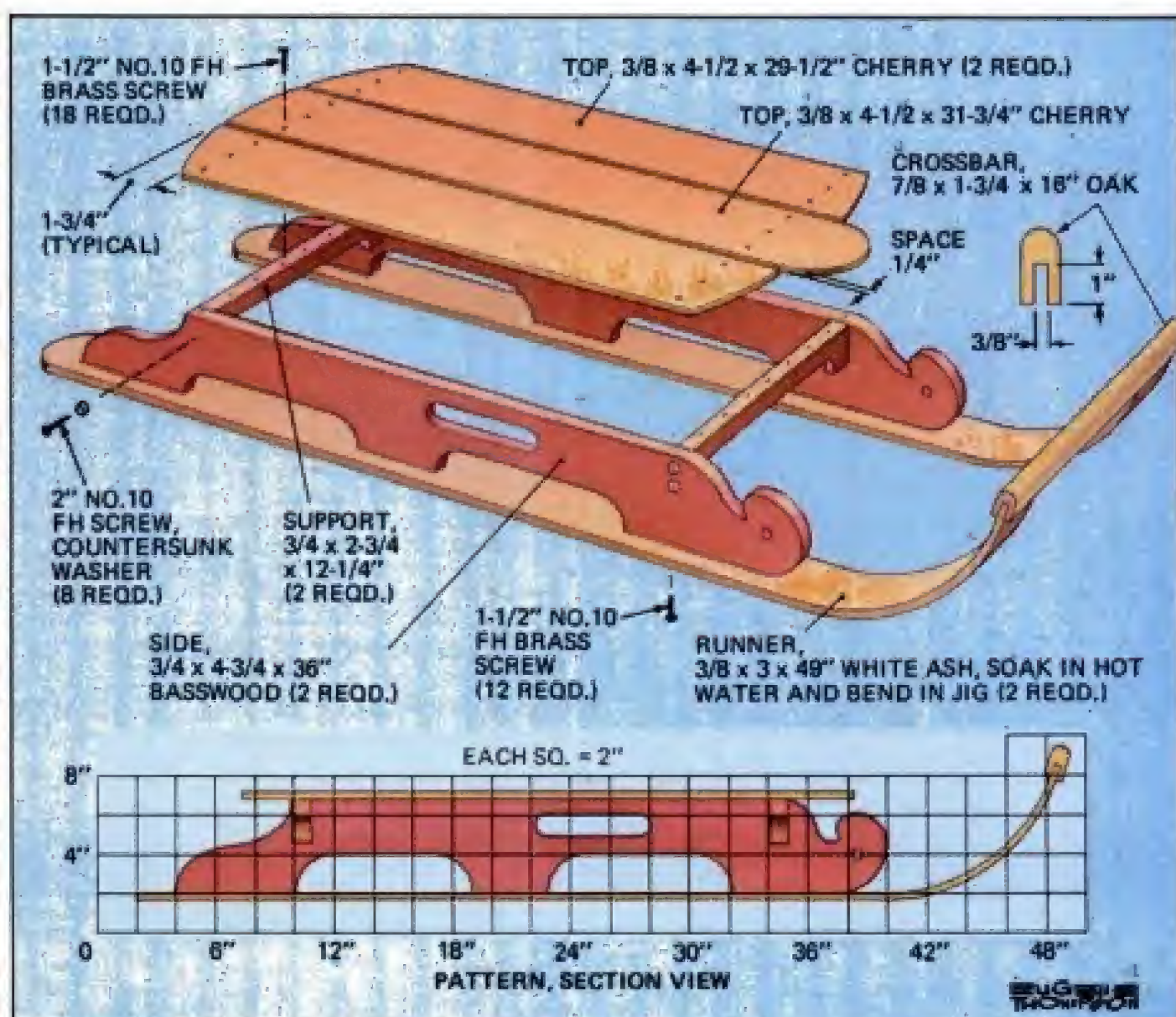
Ornate sled was built for Opfer grandchildren. He gave PM permission to reproduce plans so readers could duplicate it.

"I prefer building my own stands over the commercially available ones because I can build in all sorts of good storage for accessories for the power tool above," he says. Opfer's "good storage" is the primary reason that his shop is so neat. He truly does have a place for everything.

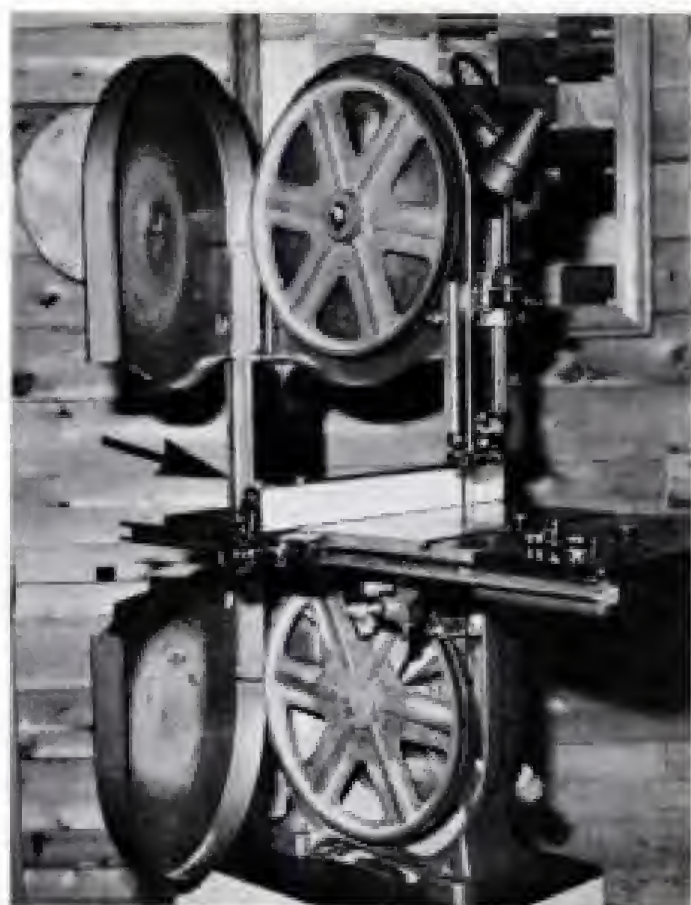
The second reason for shop neatness is that he has devised a simple but effective way to keep his shop relatively dust-free. The air is clean enough, in fact, to permit him the luxury of a Fisher

stereo sound system, which provides good music while he works. The dust-collection technique consists of ingeniously-mounted plastic fittings on power tools. One of two shop vacuums is rolled to the tool to be used, hooked up and

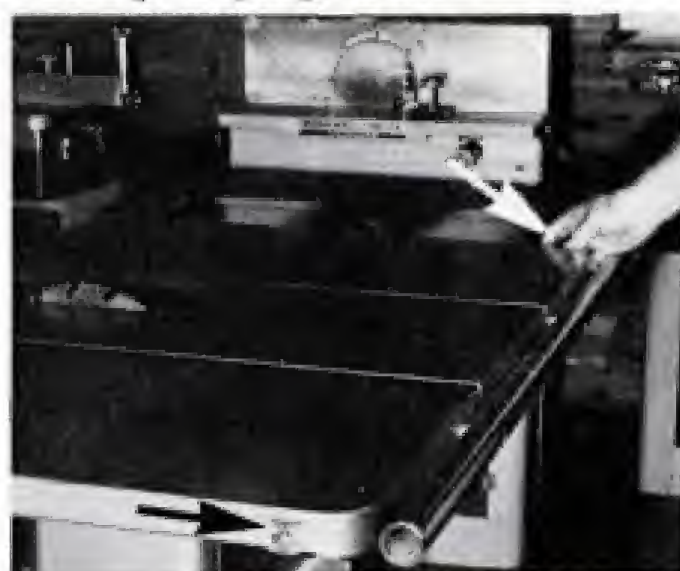
Do you know a shop that we should include in the *Popular Mechanics* Great Shop series? If so, send snapshots plus a description of shop and owner to Home and Shop Editor, *Popular Mechanics*, 224 West 57th St., New York, N.Y. 10019. If we agree, we'll visit the shop, photograph it and share it with PM readers. (Enclose a stamped, self-addressed envelope if you want your photos returned.)



This owner customizes his shop equipment



Upper and lower covers for bandsaw were made into a single door by welding a strip between and adding a piano hinge.



John Opfer eliminated original start/stop switch and installed a three-way switch on either side of table saw (arrows). Now he can turn saw on or off with either hand—no matter what size workpiece he is handling. At right, simple dust collector on grinder consists of a plastic fitting heated and forced on. Shop-vac hose is force-fitted.



switched on before the tool is used.

I particularly like his clever collector for use with the drum sander on the drill press. I have already duplicated this Opfer idea in my shop and believe that many readers will want to, also. It and several other good shop jigs are shown in the photos and drawings elsewhere in the story.

The shop is burglarproofed. Windows and door are fitted with maximum-security protection; for obvious reasons, we cannot show the details. Suffice it to say that Opfer has secured his tools with the same thoroughness that he has rebuilt them.

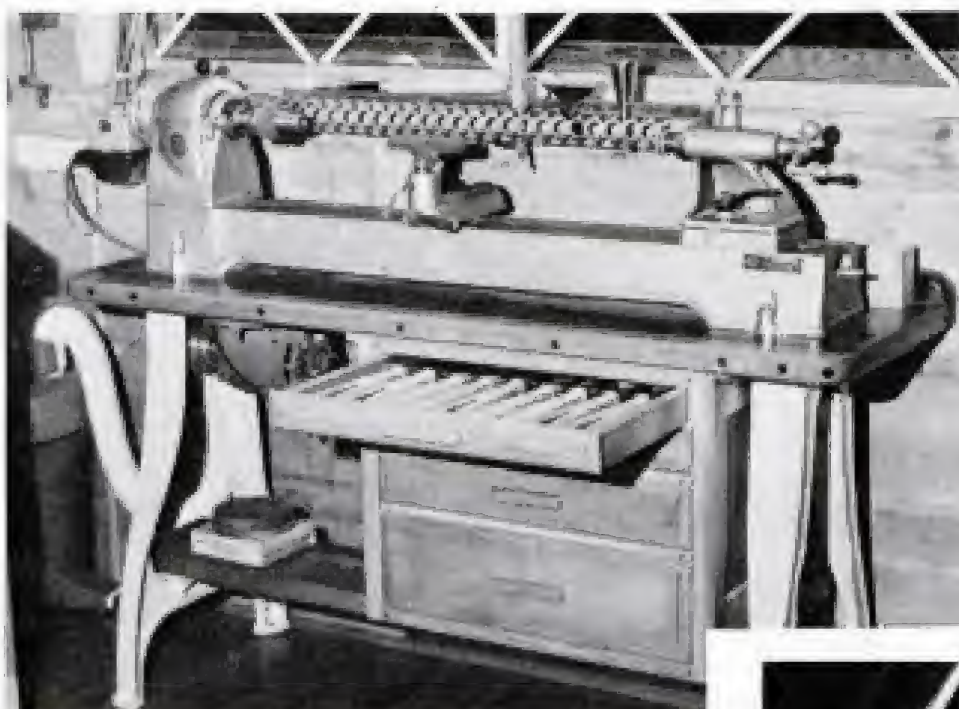
You will notice the lack of machinist tools in the floor plan. This triggers the question: "Where does he do all of the machining necessary to rebuild a tool?" The answer lies in the spacious cellar beneath his home. Here he has installed a machinist's layout that is second to none that I have seen. Limited space prevents us from showing the details here, but the heart of his workshop is his Emco 10-in. lathe.

He stores exotic lumber between the joists in the basement ceiling. Storage of routine materials such as plywood, pine and the like is in the attic over his workshop. Access to the attic is through a disappearing stairway in the ceiling.

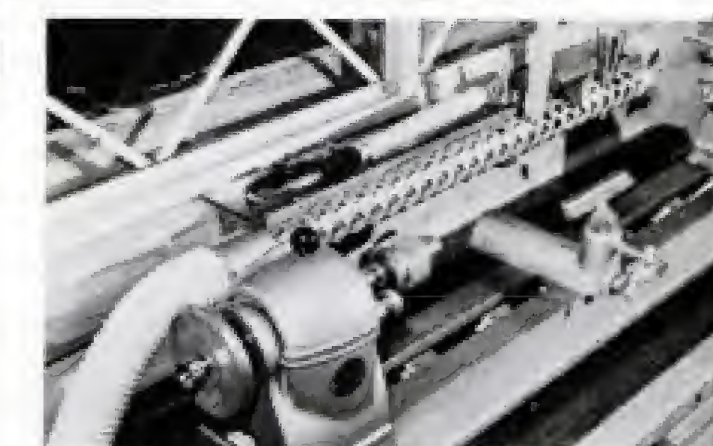
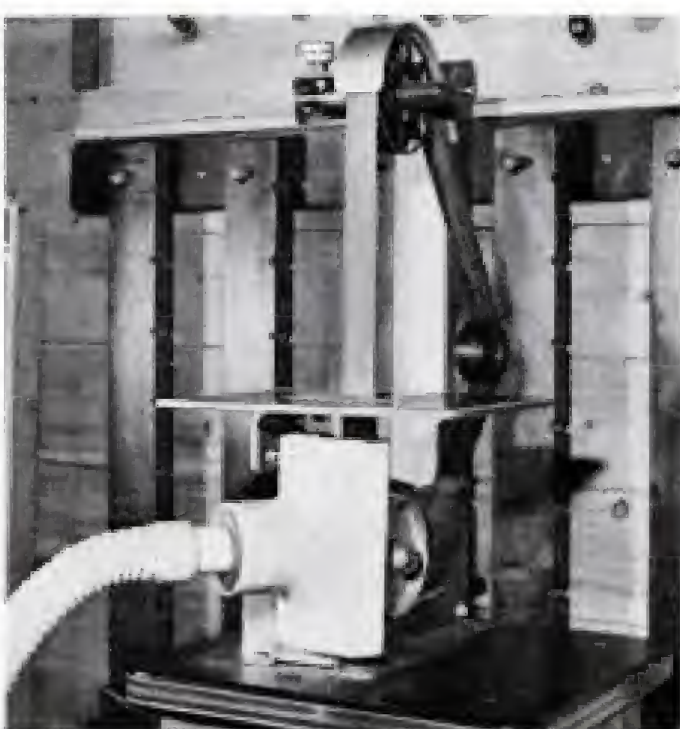
A quiet environment

Although the workshop is in the woods, the Opfers do have neighbors within hearing distance. To assure their privacy, John constructed the walls of his shop of 5-in.-diameter logs. These deaden just about all

(Please turn to page 148)



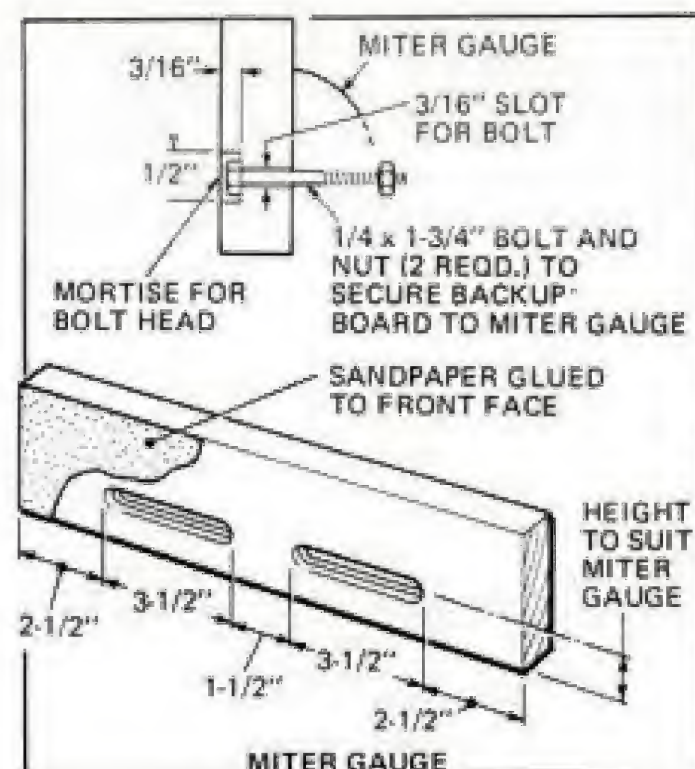
Honeycombed dust collector (left and below) is used whenever the wood lathe runs. Shop hose fits in one end, and the other end is capped. Owner says he would eliminate one row of holes if he were remaking the collector. He also uses holes as a rack for chisels when turning at lathe.



Collector for sander/grinder is a vacuum-hose fitting heated and pressed on tool.



Author particularly liked miter gauge add-on. It eliminates cutting through backup board. Drawing shows how it's made.



A master craftsman's workbench (and one for a junior craftsman, too)

Here are three super workbenches—you can build two from our plans and assemble the third from a kit.

Most craftsmen will agree that a solid workbench is the heart of any workshop. All shop activity radiates from the bench. You use a bench for planning a project and laying it out, for cutting, sanding and assembly and, with care, for some finishing operations.

Contrary to popular belief, most

craftsmen do not stand at their benches all day. More often than not, the project itself is mounted on a pair of sawhorses or portable bench located in the center of the shop. This way, the workshopper can attack his project from all sides. He usually keeps hand and power tools that he is using on the close-at-

hand workbench. And he turns to the bench and uses it for the tasks spelled out above.

Based on typical workshop use, there are four basic criteria to meet

Workbench designs and construction: Rosario Capotosio and Harry Wicks. PM photos: Craftsman workbench, Rosario Capotosio; junior workbench, Julius Spedale. Technical art: Eugene Thompson. Floor covering: Brite Bond by GAF Corp.





- 1 Pop's bench is rugged, easy to build.
- 2 Shelf stores small items conveniently.
- 3 Vise stop allows top-of-bench work-holding.
- 4 Roomy top is made of oak strip flooring.
- 5 There's ample storage below for large items.
- 6 Kid's bench sports a small, portable vise.
- 7 A shelf unit like Pop's features two drawers.
- 8 Hardboard dividers separate tools on shelf.
- 9 Junior bench suits 8- to 12-year-olds.



1/4 x 1/2" RABBIT

1/4"

1/8 x 1/4" DEEP GROOVE

BB

AA

Y

Z

KK

15/16"

6-1/8"

15/16"

3/8"

1/2"

3-3/8"

1/4"

3/8"

4-1/4"

1/8 x 1/4" DEEP GROOVE

DETAIL 2, DRAWER FRONT Y

3/8" DEEP
x 3/4" -
RABBET

1-1/4"

II

3/4"-DIA. HOLE

DETAIL 3

T

U

T

X

1/8 x 3/8"-DEEP
RABBET

2-1/2"

3-1/2"

10-3/4"

K1

**DETAIL 4,
CABINET ATTACHMENT**

**DETAIL 6,
SHELF ASSEMBLY**

(For materials lists and remainder of main text, please turn to page 164.)

The bench kit is carefully prepared for



Since assembling the bench, I have to admit that I use this one with greater frequency than the other two benches in my shop (one is a shop-built and the other a European import). I particularly like its generous work surface and stability. Model A bench is priced at \$359, plus shipping charges, from Garden Way Research, Charlotte, VT 05445. Write the maker for additional buying information or call 1-800-451-5088 (it's tollfree.)—*Harry Wicks*



NOVEMBER 1980 115

Build PM's CONTEMPORARY TOOLBOX

It'll be an heirloom

Because toolbox is hefty
—even when it's empty
—it is fitted with a re-
movable strap for over-
the-shoulder carrying.



PM photos: Julius Spedale

It's more than just a toolbox (above). Drawers let you carry small hardware and the like; top serves as work surface. Handle is adequate for short lifts (left).

A toolbox's basic function is to store tools conveniently for easy job-site usage. But the challenge we gave designer David Stiles was to come up with a contemporary version that would do more, and would appeal to today's craftsman.

We asked Dave to incorporate such features as storage and on-the-job conveniences. He met the challenge by coming up with a toolbox that could aptly be called a "portable workshop." It includes these features:

- A work surface you can use for assembly and sawing, and other carpentry operations.

- Safe storage for your prized 26-in. handsaw.

- A retractable bench stop for planing or sanding wood.

- A helpful shoulder strap that takes some of the weight off your arms when carrying the box from one job to the next.

- Four drawers for the storage of small tools and materials (this is especially helpful when you consider the figures released by the National Association of Homebuilders, revealing that professional carpenters spend 15 percent of their time looking for tools or materials).

- A V-notch in the bench stop which lets it double as a "vise" of sorts. This is handy when you have to cut dowels or pipes on the jobsite.

- A bonus is the fact that the top shelf can double as a short stepladder.

For looks, we built the box of many-layered Baltic Birch plywood. Its multilayers provide an attractive finish and no edge work is required beyond the final sanding with 120-grit sandpaper. Chances are you will have to ask your lumberyard to order the plywood from the same source that provided ours: Allied International, Box 56, Charlestown, Mass. 02129.

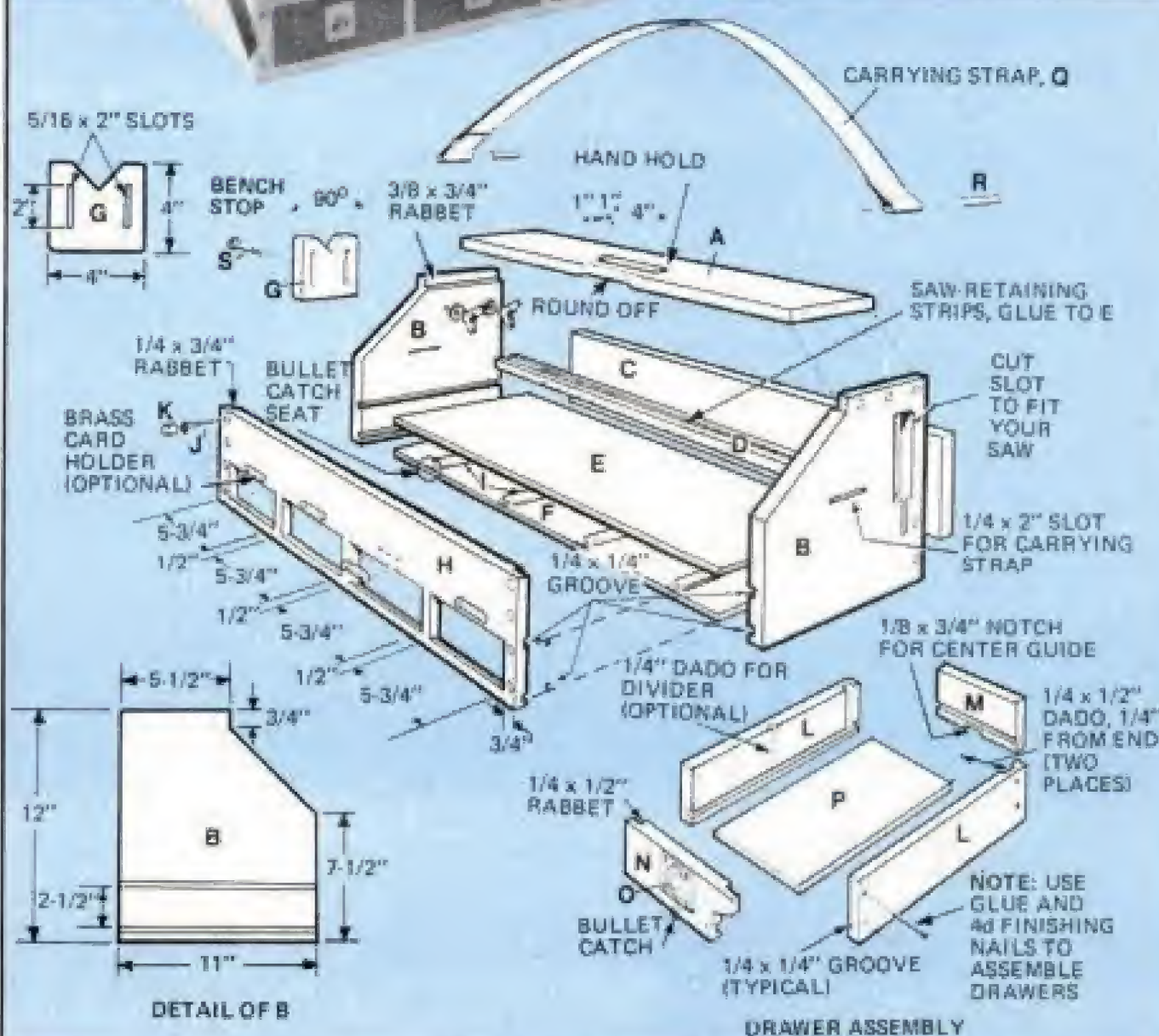
If, for some reason, you cannot obtain this imported plywood, you can do perfectly well by using solid-core plywood as a substitute.

How to build the box

1. Start by cutting the individual pieces to size. Use a sabre saw to cut out the drawer holes, being extremely careful to make the cuts straight and square.

(Please turn to page 149)

An excellent feature is the adjustable stop at one end of the "workbench." The block (G) has two slots which straddle a pair of bolts. To adjust it up or down, you loosen a pair of wingnuts, as shown at right.



9 woodworking secrets from PM's master craftsmen

Over the past three years, *PM* has published articles featuring good shop ideas from master craftsmen—professionals who earn their living by their special shop skills. *PM* readers have responded to these articles with great interest—often with ideas that are worth sharing. Thus, in this roundup, the sixth

in the series, we have collected great shop ideas from *PM* reader/craftsmen—people who turned to shop work as a hobby or part-time business, and have acquired considerable skills along the way. Besides some dandy tips, you will find a couple of the best jigs you might ever make for your shop.

Auxiliary router base molds curved edges

Shaping the edges of a free-form curved shelf unit before assembling the sides makes it nearly impossible to accurately mate the curved, shaped edges where shelf and sides meet. Shaping all the edges afterward makes the task simpler.

To make a router base for this task,



Convex router base lets you shape curved edge, is guided by piloted bit.

cut a softwood disc to the diameter of your router base. Mount the disc on a lathe faceplate and turn it to a convex shape having a radius no greater than the smallest radius in the curved edges of your project. Hold router perpendicular to tangent of each inside and outside curve.—*Emery J. Loiselle*



To make base template, trace smallest-radius curve onto stiff cardboard.



Turn softwood disc to required shape, using the template to check progress.



To use, remove the original base and screw the convex base in its place.



Rub treated rope against grooves of bit.

Make rusty auger bits shine

You can clean a rusty auger bit until it shines like new. Squirt a few drops of machine oil on a piece of manila or sisal rope. Then roll it in some fine sand or powered pumice until the surface is coated. Wind the rope once around the bit and pull the ends back and forth to remove the rust, working your way from the shank to the tip. Select a rope size to match the groove of the bit being cleaned.—*Ralph S. Wilkes*

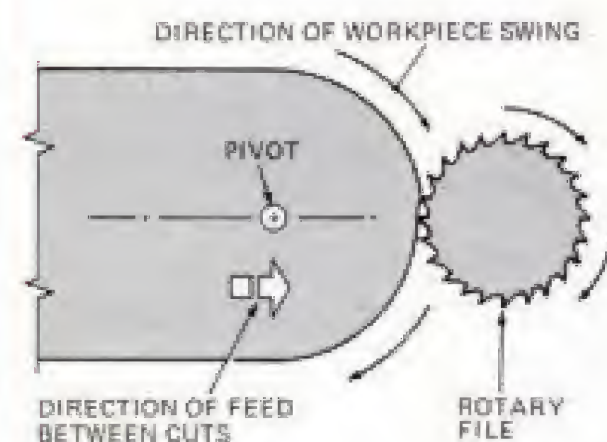
Round ends neatly

It is often desirable to produce rounded ends on strips of metal, hardboard, or other material, with each curve's radius extending from a hole for a screw or rivet. This method makes it easy.

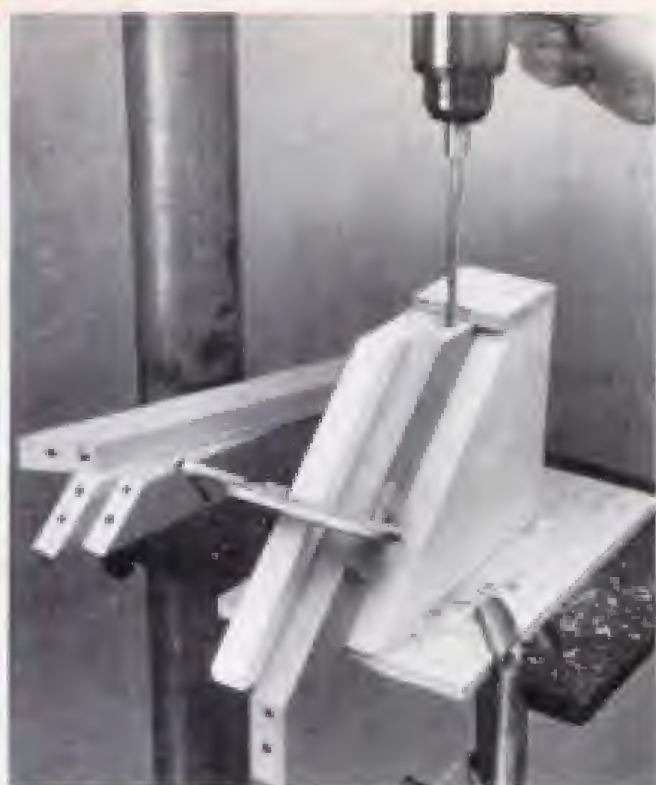
Drill the required holes in work and rough-cut rounded ends on a saw. Choose a nail with the same diameter as the hole and drive it into a wooden block. Then clamp the block in a drill-press milling-table vise and cut off the pivot nailhead. Be sure the centerline of the work is aligned with center of rotary file.—*Walter E. Burton*



Milling table allows work to be fed into the rotary file at $\frac{1}{16}$ in. per pass.



Swing strip so its end moves against the rotation of the file, as shown here.



Align bit with point to be drilled and then clamp the jig to the drill-press table.



To assemble frame with mitered joints, you first join two diagonal corners.

Drill accurate holes for doweled miter joints

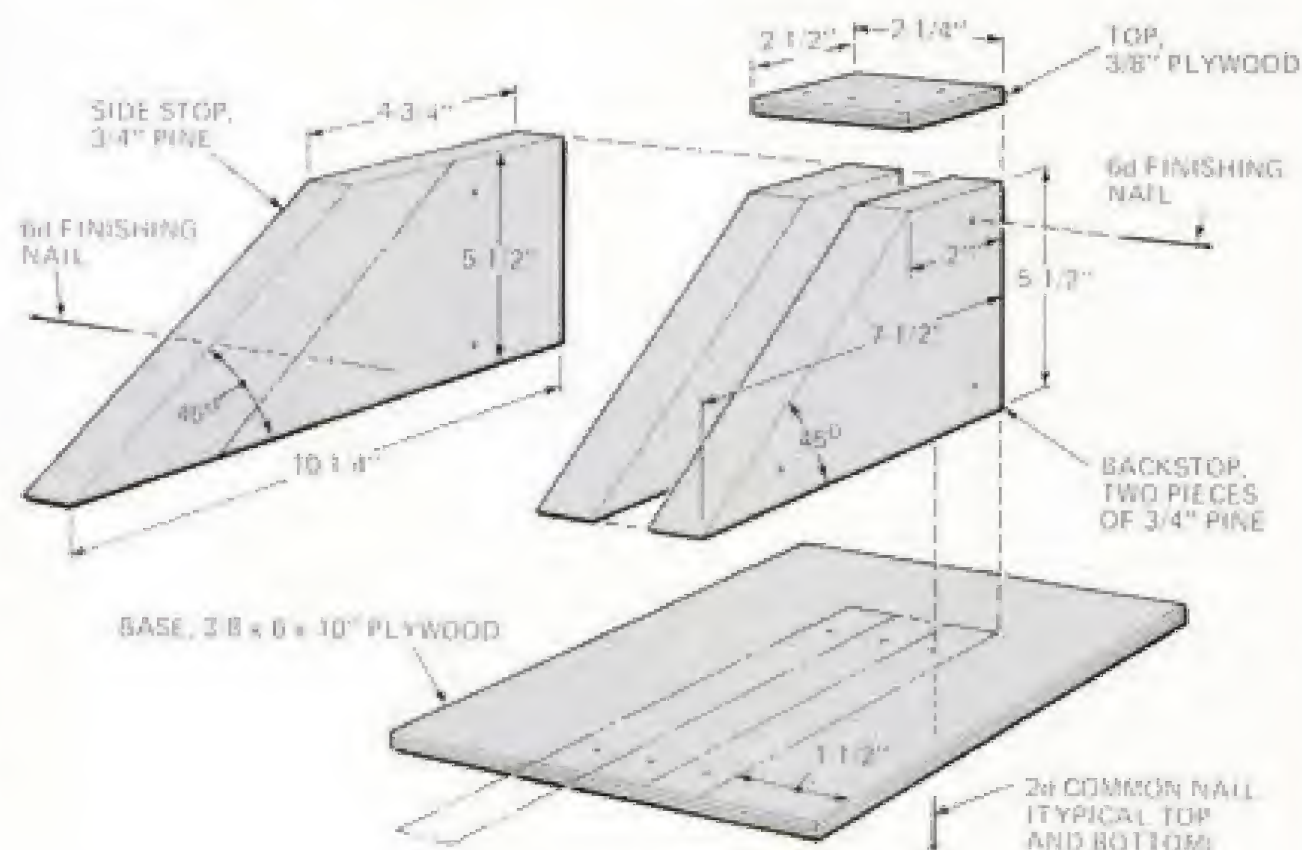
This jig, designed for use on a drill press, will enable you to accurately drill dowel holes perpendicular to the face of a 45° miter. Use a single piece of 3/4-in. stock for the side stop and a doubled-up piece for the back stop. Cut the top and base to the plywood dimensions shown in the art.

To use the jig, set the drill depth stop as required and clamp the work to the jig.

Mark a centerline on the mitered edge

face and position the jig so the drill point is on dead center. Then clamp the jig to the drill-press table. If you are using two dowels for each joint, drill the first holes in all the pieces before shifting the jig into position for the second set of holes.

Note that assembly of a framed construction must be done in two phases: First assemble two diagonal corners, then join the others in unison.—*Ralph S. Wilkes*



Making your own large-size molding

You can make a large-size piece of concave molding using a saw, a small shaper and a belt sander. First make a pattern of the molding cross section. Cut a piece of stock to the right overall dimensions and trace the pattern on one end. Next, cut away surplus using a table saw. Using a 3/4-in. core box bit, make several passes to approximate the

molding's shape. Readjust the cutter height and the fence after each pass.

Finally, use the jig shown to support the workpiece while smoothing the concave surface with a medium-fine belt. Clamp the jig securely to the sander stand top and sand along the cove by hand to remove any scratches.—*Ralph S. Wilkes*

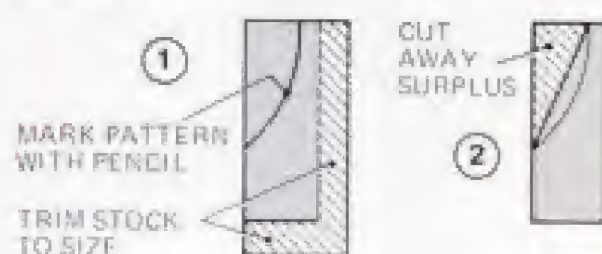


Use core box bit to rough-shape molding. Adjust the bit and fence for each pass.

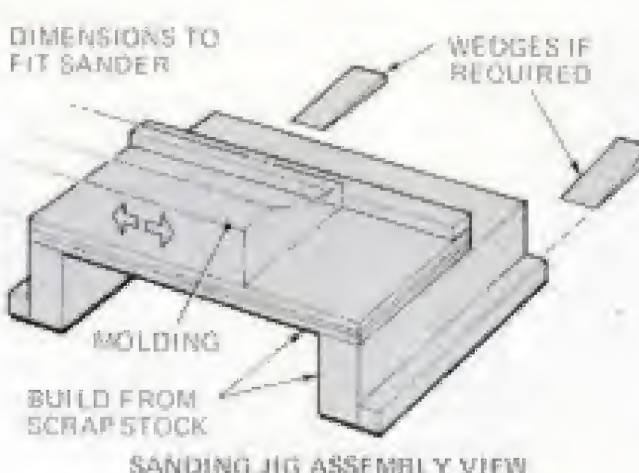
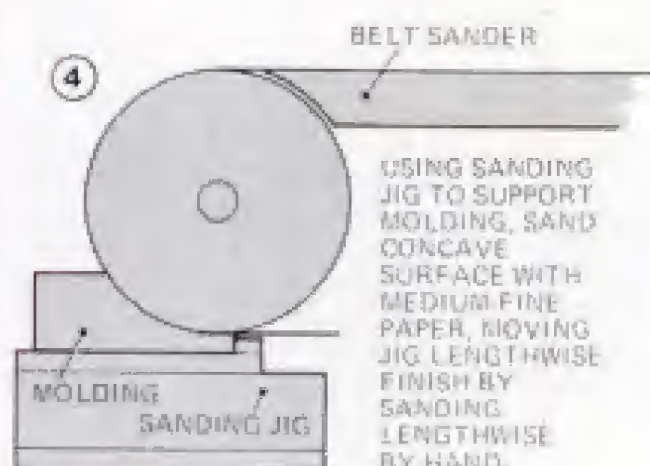


Support molding on jig and move laterally against the belt sander to smooth it.

(Please turn to page 182)



SHAPE MOLDING IN STAGES BY MOVING FENCE AND ADJUSTING DEPTH OF CUT ON EACH PASS



AVIATION

Airport ahoy!

The Nimitz was never like this. The floating airport you see below would offer its passengers duty-free shops, banks and travel agencies, a movie theater, bar—and a 1953-foot runway capable of handling four-engined, 50-seat planes.

If Seaforth Maritime Ltd. of Scotland wins the financial backing it needs to develop the \$165 million craft, it could brighten gray, blustery winters for North Sea oil-platform workers. It could also cut costs of 470,000 yearly passenger transports.

Currently, the flow of men to and from North Sea rigs is anything but smooth. To get to work, crews take off from Aberdeen, Scotland, then transfer to helicopter up north in frequently foggy Sumburgh for a noisy, slow trip out to sea. Floating on pontoons, the Seaforth Stolport would accommodate the De Havilland Dash 7 short takeoff and landing (STOL) aircraft, which

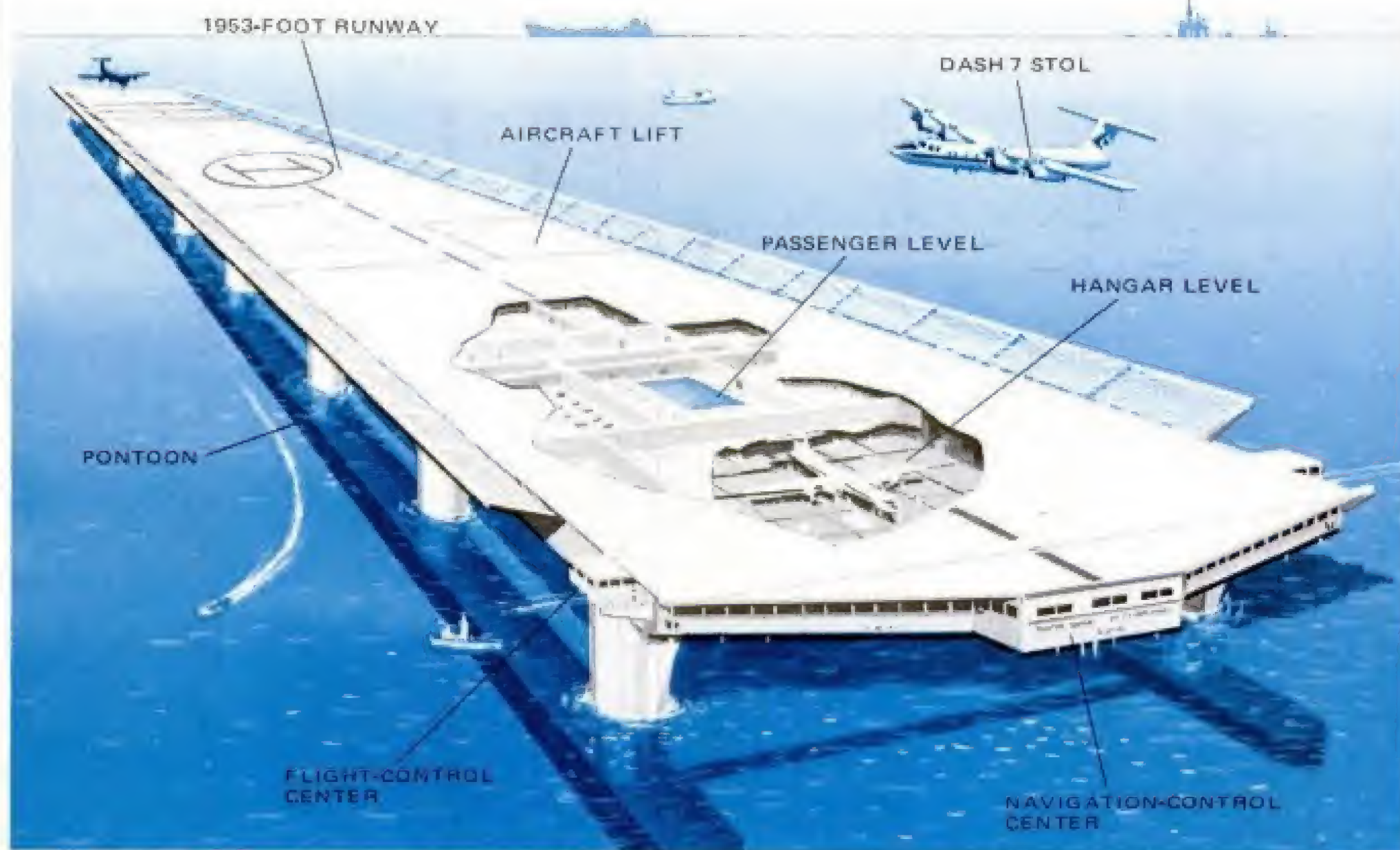


Fly-casting takes on a new dimension in the Humbug ultralight with Styrofoam floats (from \$4400 from Sky Sports Inc., Ellington, Conn. 06029). The 120-pound craft, with a 35-foot wingspan, takes off at about 20 mph.

could fly to the carrier near the rigs. There, men would transfer for a short helicopter trip.

Plans for the stolport, almost twice as long as the U.S. Navy's Nimitz carrier (1092 feet), call for two levels under the runway. The lower level would house aircraft.

Upper-level living areas would include a hospital with facilities to treat divers. "You could build in whatever you wanted," a Seaforth spokesman told us. "Sports arenas. Hotels. You could house wives there, and workers could commute to the rigs." **PM**



Three-level floating airport would serve 17 oil rigs, with space for recreation, banks, a hospital, shops and hangars.

ENERGY

Westinghouse's wand

Westinghouse Electric Corp. is about to begin large-scale testing of a process that uses a kind of wand to pull solar cells out of a vat.

Westinghouse developed the technique for the space program, and revived it during the energy crisis. It's comparable to dipping a child's bubble wand into soapy water, and withdrawing a chain of bubbles.

In the complex Westinghouse equipment, the "wand" is a tiny filament dipped into silicon at 2650° F. A bead forms at the tip of the filament. Two small posts sprout out of the bead. As the filament is extracted, the silicon forms a web between the posts. At a rate of nearly 6 feet an hour, the web cools to a smooth, single-crystal ribbon, later cut into strips.

Silicon strips are the heart of photovoltaic cells that absorb energy from the sun to produce electricity.

Pacific Gas & Electric Co. and Southern California Edison recently committed \$300,000 each toward the operating costs of a 50-kilowatt-per-year pilot facility to be built by Westinghouse. By 1986, a larger, fully automated plant should be turning out cells at a cost of 70 cents a peak watt. Costs currently range from \$7 to \$22 a peak watt.

Watered-down fuel bill

A Bayville, N.Y., inventor reports cutting his fuel bill 14 percent by using a process which adds water to the oil his furnace burns.

Inventor Eric C. Cottell, who holds patents on methods to keep cold cream and suntan lotion from separating, began research on energy-related devices decades ago.

During the critical oil shortage induced by the Suez crisis of 1956, he powered his motorbike with an oil-water mixture. Today, Cottell has used this expertise in emulsions—suspensions of one liquid within another—to mix water and oil into a milky-orange fuel which, he says, saves



Cottell uses "emulsion integrator" (inset) to mix water, heating oil.

money and also cuts pollution.

An install-it-yourself kit, he says, should retail for \$30 and could be on the market in six months. The market appearance of the process, however, depends on when Cottell finds a manufacturer. (He has designed a similar device for diesel engines that is not yet on the market, either.)

The main component in the kit is an "emulsion integrator," which premixes the oil and

water. Operating on just the water-oil pressure, it consists of a series of propellers rotating in opposite directions. The emulsion flows into the burner's high-pressure pump. Minute water droplets disperse within oil drops. As the atomized emulsion is shot out the pump nozzle, the water particles explode at about 270° C., ripping the oil droplet apart.

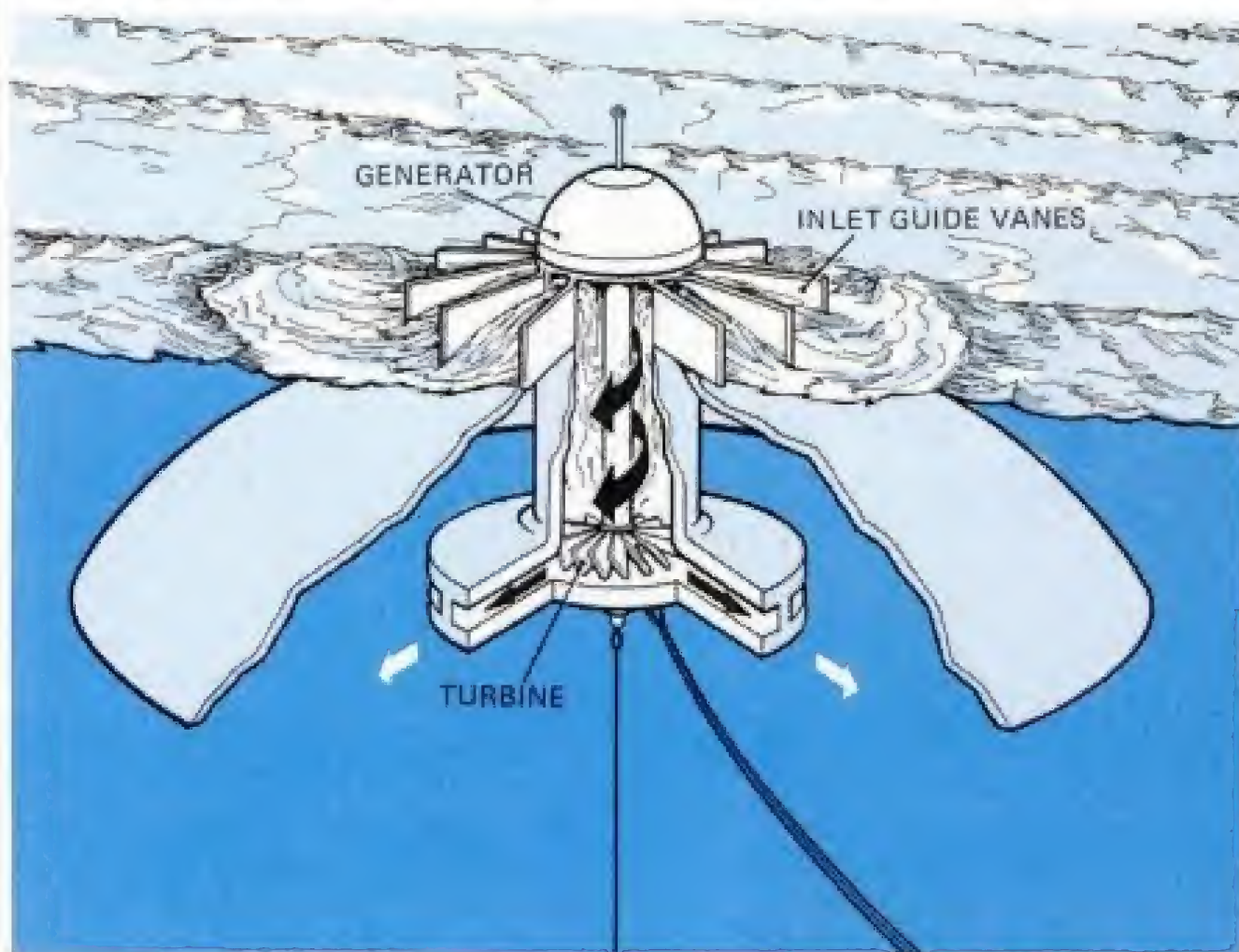
Home-furnace emulsion systems have not always fared well in controlled tests. Brookhaven National Labs in Upton, N.Y., reported that one system it tested in 1977 used extra oil to heat the water, decreasing efficiency. Cottell maintains that the high-temperature explosion of water droplets in his patent-pending system will give the homeowner a longer time between oil deliveries and a short payback period.

Watts from waves

The artificial atoll (below) draws energy from ocean waves to generate electrical power.

Lockheed Missiles & Space Co. is developing the "Dam-Atoll," a moored, 280-foot-diameter dome arching over a cylindrical central core.

As a wave slows its speed when it hits the outer lip of the dome, the water bends or refracts. Vanes guide the curving water into the core where a whirling vortex turns a turbine. **PM**



Like light entering a new medium, waves bend when they hit shoal.

PRODUCTS

Facing the cold?



Mask aids cold-weather breathing.

The woman in the photo above is wearing 3M's Micropore cold-weather mask, designed to make breathing easier for asthmatics when they are outdoors in cold weather. The St. Paul, Minn., company says the \$5.67 mask is also beneficial for other active people breathing chilly air.

Photovoltaic kit

The HomeOwner Series of photovoltaic generators run lights and appliances. The model shown below produces 360 to 640 watt-hours per day, depending on geographic location and weather; it

costs \$3135. Price includes three 12-volt storage batteries, pole mount, battery cover, voltage regulator/load terminal and voltmeter/ammeter. The four-foot-square panel puts out enough juice to run a few lights, a TV and a small fridge. The system is available in kit form from Solarwest Electric, 1124 Coast Village Circle, Santa Barbara, Calif. 93108.

Waste-heat recycler

Ever feel the exhaust from the condenser of an air conditioner? It's hot—hot enough to heat water, for example. The Heat-Wringer from Lennox (Box 400450, Dallas, Tex. 75240) captures some of that heat and transfers it to a home's hot-water tank. At \$400 to \$600, installed, the unit has a payback period of 2 to 2½ years in places like Florida, Lennox says. It also allows an air conditioner or heat pump to run more efficiently. **PM**



Unit cuts heat-pump energy losses.

INVENTIONS

Underwater eyes



Diver probes pipe for hidden flaws.

The "gun" in the drawing above fires sonic pulses at oil-rig structures to uncover flaws.

Inventor H. Dale Collins of Richland, Wash., told us the 160-element ultrasound array bends to conform to contours of parts under inspection. In addition to ultrasound images, the gun feeds TV pictures of part surfaces to a minisub. (Patent 4,212,258.)

Wake watcher

Newly patented equipment mounted on the trailing edge of an aircraft wing helps researchers determine drag and improve airfoils. NASA holds patent 4,212,199 on pressure-sampling gear analyzing aircraft wake. Goal is better fuel efficiency. **PM**

New spaghetti twist

A Swiss inventor has reinvented the wheel—as a way to wind up unraveled spaghetti.

Janos Zapomel's invention attaches to a dinner plate. A diner puts a fork carrying a disordered tangle of spaghetti into a circular opening in the accessory, and rotates a hand wheel. With just a few turns, strands are wrapped tightly around the fork. There's no word yet on whether Zapomel's wheel is guaranteed for the first 40,000 miles of spaghetti. (Patent 4,211,372.)



Solarwest cells could provide power for homes that don't have electricity.

AUTOMOTIVE

Porcelain parts

In their feverish search to reduce weight and increase gas mileage, auto makers are turning to materials that have never before been considered practical for use in auto parts. The newest candidate receiving a fair amount of interest is ceramics.

Ceramics: hot item

Long considered as suitable only in bathroom fixtures and decorations, ceramics has caught Detroit's eye because of its resistance to wear, corrosion and extremely high temperatures.

And its low cost, light weight and ability to be formed into complex shapes makes it more attractive than magnesium alloy, for example, which is very expensive.

The first ceramic parts will probably be compressor shoes on airconditioning units, pushrod tips, turbocharger rotors, lifters and rocker arms on diesel engines and precombustion chambers for gasoline engines.

As the auto makers acquire more experience with the material we're likely to see even more complex and highly stressed components.

Not far down the road: ceramic pistons.

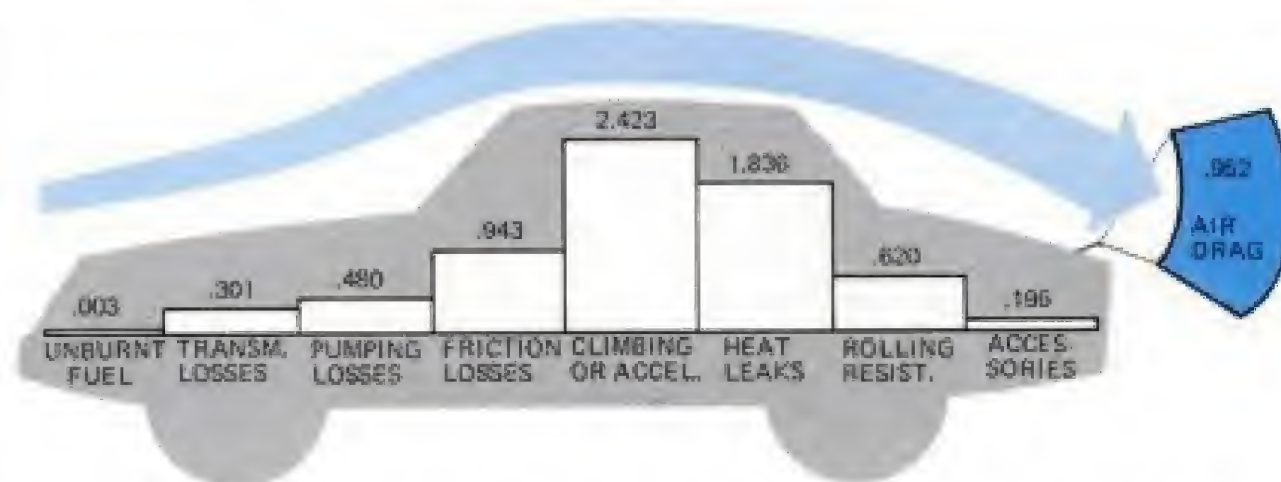
Cheating the wind

Renault recently uncovered some interesting facts about how an engine's efficiency is affected by internal and external factors such as friction and air drag.

The French car maker drove a Renault 20 TS four-passenger sedan over a 100-mile loop. The 7.753 gallons the engine consumed in the test were broken down to determine where the energy of combustion had actually gone.

Fuel goes up in thin air

Of the 7.753 gallons consumed, only 2.423 gallons actually did the "work" of moving the car. The remaining 5.330 gallons were essentially "lost" through heat loss, friction, roll-



Of the 7.753 gallons burned by the engine in a 100-mile test, only 2.423 gallons were actually used to move the car. Air drag ate up almost one full gallon.



Renault engineers confer in a wind tunnel on ways to streamline future cars.

ing resistance—and air drag.

The chart above shows that air drag consumed a bit more fuel than the engine's internal friction loss—almost a whole gallon.

Car makers know that overcoming internal friction and heat loss requires an expensive and lengthy research program. Some makers think that those two areas can never be significantly improved.

Beating the drag

But air drag can be overcome, and fairly inexpensively. It is far cheaper to bend sheet metal into a slippery shape than it is to redesign an engine or driveline with built-in low friction.

When Ford was designing its newly introduced Escort/Lynx, for instance, engineers discovered that by putting a small $\frac{1}{8}$ -inch radius on the leading edges of the hood and fenders they could improve mileage by 0.5 percent.

All car makers are currently involved in aerodynamic research. As a result, cars in the

near future will be able to slither through the air without so much as a ruffle. **PM**

Mt. St. Helens: polluter

Environmental Protection Agency (EPA) sources tell us the agency has had a hard time monitoring pollution out West ever since Mount St. Helens began blowing its top.

The problem is distinguishing man-made pollution from Mt. St. Helens' natural volcanic pollution. A further surprising item: They told us some late-model cars are so efficient at cleaning up emissions that, apart from carbon monoxide, their exhaust is cleaner than the air, laden with smog and volcanic dust, entering their carburetors. So far, however, no one at EPA has suggested hiring drivers to cruise through heavily polluted areas in their new cars to clean up the atmosphere.

ELECTRONICS

Now: Supertapes

This is the year of the supertapes. First came metal tapes; now come double-layer tapes and tapes with vastly improved recording characteristics. All would seem to fulfill an audiophile's hopes for a cassette good enough to compete with the discs produced by studio techniques such as digital mastering.

One important development comes from BASF, a leading producer of industrial chemicals and a pioneer in high-pressure technology. The unique high-pressure reactors at the BASF plant in Ludwigshafen, West Germany, have now been called into service by the company's tape division for processing the chromium dioxide used in chrome recording tape. This treatment gives the tape greater "coercivity."

Coercivity is a key concept in magnetic recording. The term refers to the strength of the magnetic pulse needed to impress the signal onto the tape—in other words, how strongly the tape must be "coerced" to accept the signal. High-coercivity tape retains the signal more accurately because greater force is needed to disturb the recorded sound patterns once they are magnetically set on the tape.

In many tapes, the magnetic particles tend to revert slowly to

a random order after recording. This decay partially wipes out higher frequencies because highs require a more intricate magnetic pattern than lows. Thanks to its greater coercivity, BASF's new chrome tape—called Professional II—resists such magnetic disorientation and renders clearer, more accurate highs.

Measurements show that this new "super-chrome" yields from 4 to 6 decibels better response in the region above 10,000 Hz than chromium dioxide formulations used before. This gives the tape capabilities comparable to those of the far more expensive pure metal tapes. Professional II requires no special adjustments on the recorder and can be used on any deck equipped to handle chrome tapes.

Low-hiss cassette

Another new wrinkle in tape technology comes from TDK in the form of their new SA-X cassettes. These use a double layer of magnetic particles. Both layers consist of Super-Avilyn, a magnetic coating substance whose exact nature is TDK's well-kept secret. But the top layer is specially treated to make it more responsive to the upper frequencies, while the lower layer is optimized for bass. The idea is to provide each extreme of the musical range with a magnetic medium most congenial to it.

The dual-layer format has another advantage. Whenever a tape formulation is optimized for

treble response, it also tends to increase hiss. Since the bass-grabbing bottom layer in TDK's new tape needs no treble response at all (that job is done by the upper layer), it's formulated for minimum noise.

BASF's Professional II lists for \$3.49 for a C-60 (one-hour) cassette, and the TDK SA-X is \$6.

A game that grows up



Shoot the rocket, or the works.

TV video games helped begin the computer revolution by getting people accustomed to using their television set as a display. Now, a video-game manufacturer, APF, is offering add-ons to turn a simple video game into a full-fledged home computer.

APF's MP1000 console with a shoot-the-rocket game sells for \$129. For an additional \$500, it can be expanded with a full keyboard unit and BASIC programming language. The package sells for \$600 if purchased all at once.

The fully assembled computer offers built-in sound, as well as an eight-color display.

In testing the unit, we found the programming to be simple, although the MP1000 won't compete in some areas with either the Apple II or the Atari 800 computers. The color resolution is not as good, and letter display is coarser. But for \$600, the game that grows up is attractive.

Additional equipment

Another \$200 buys you an accompanying piece of equipment called the Building Block, permitting you to plug in other accessories such as additional memory and floppy disc drives. In fact, APF will be supplying enough reasonably priced peripherals to enable steady growth of the system that will satisfy most owners' growing interests.

PM



The scenes above come from *Odyssey*, a new computer game for the Apple II. The program calls on players to amass money and men and explore



several computerized islands before a final battle. The game from Synergistic Software costs \$35—cheap for a do-it-yourself epic.

RECREATION

Do-it-yourself fun

"Child's play" supplies much of the power for Sesame Place, a new 15-acre amusement park in Bucks County, Pa.

Aimed at the 3- to 13-year-old set—adults are excluded from many of the amusements—the park, 30 minutes north of Philadelphia, capitalizes on kids' natural interest in gizmos and gadgets to teach them about science, technology and human physiology. Energy to run many attractions comes from children themselves.

A pedal-run generator turns on green neon lights in proportion to current produced by the pedaler. A set of facing parabolic dishes bounces whispers back and forth over some 30 feet. Steel balls dropped by children whip around the inside of a huge black funnel, following some of the same orbiting laws as satellites. Electronic machines grind words spoken in a mike into gravelly noise or high Mickey Mouse talk to teach the principles of pitch.

Its developers, the Children's Television Workshop—creator of TV's Sesame Street—and Busch Entertainment Corp., view Sesame Place as a prototype for other parks, each low in scale and high in hands-on technology.

One highlight for youngsters we saw during a recent visit is a gallery crammed with custom-designed computer games. No penny arcade, the two-floor gallery offers dozens of keyboards for kids to use, often to type out responses to questions on Sony color TV screens. (If lemonade costs 4 cents a glass to make, and it's a cloudy day, how many glasses do you want to try to sell, at what price? Punch in the answers and the screen tells you whether you made money.)

"I like this better than a roller coaster," one 9-year-old said, "because you do something." **PM**

Editor: Gurney Williams III

Contributors: Tony Assenza, Glenn Butash, Ben Dunlap Jr., Hans Fantel, Stacy V. Jones, Tom Sahagian, Neil L. Shapiro, Gary Witzenburg



Youngsters at Sesame Place watch steel balls circle walls of giant funnel.



Child mulls computer-made puzzle.



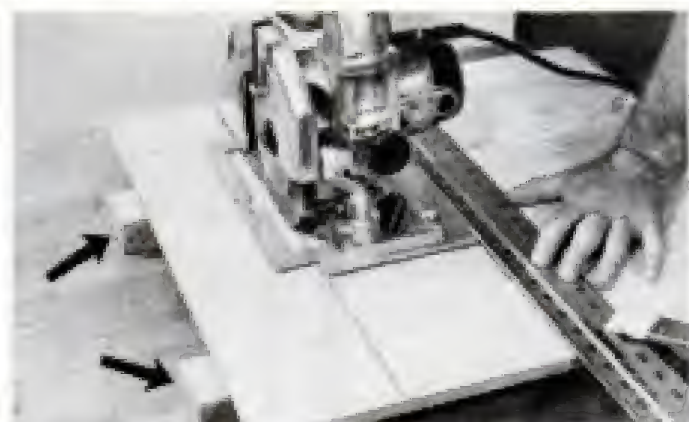
Pedalers generate power for lights.



No penny arcade: Quiet computer gallery sharpens intellectual skills.

WORKSHOP MINICOURSE

USING A PORTABLE POWER SAW



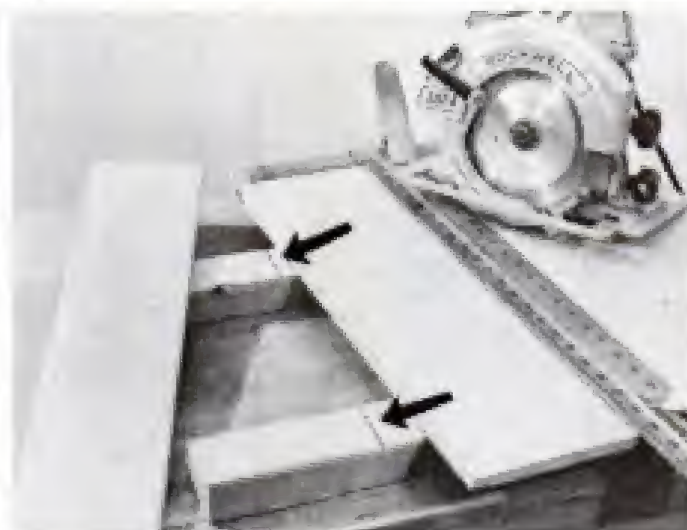
My preferred setup for working with a portable circular saw is to position two lengths of 2x3 beneath the workpiece as shown (arrows). These are used whether working on the workbench or across sawhorses. A third 2x3 is used beneath the cutoff portion if the waste piece is large.



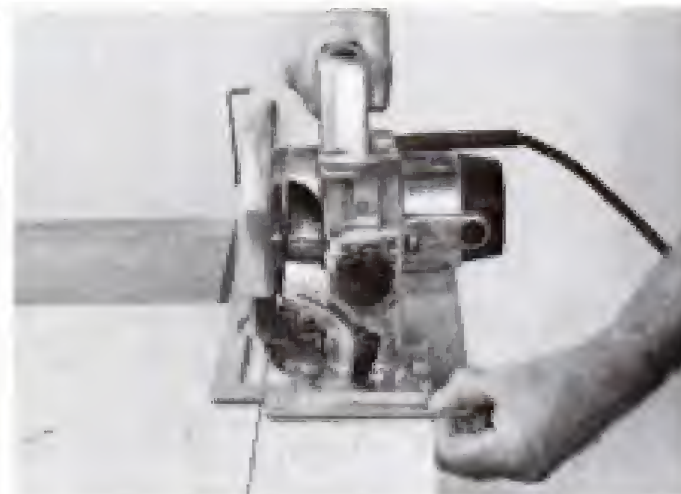
Use the manufacturer's rip guide when cutting accuracy is important. To use, secure it to saw shoe so the blade cuts on the waste side of the line when the guide is on the work edge. Keep the guide in contact with the edge throughout the cutting.

For my money, a portable, circular power saw is one of the priority tools to be added to a home do-it-yourselfer's power-tool collection. Using one, you can make many on-the-job cuts that are similar to those you do on the table saw; it just requires a little thinking beforehand. For example, you can plow grooves, rabbets and dados by making accurate, repeated, overlapping passes with the blade. You must know how to set up properly, however, to avoid any chance of accident or wasted materials.

The best setup that I know of for on-the-job power sawing is to lay three or more 2x3s across a pair of sturdy sawhorses. With this number of supports, you can always make certain that the material on both sides of the cutting line is fully supported. This is no problem, of course, when the cutting line is perpendicular to the 2x3s, as in the photos. But making a long cutoff, such as along the length of a piece of plywood, can pose difficulties. Here, two lengths should be below the larger piece of



With blade set to just cut through the work, saw kerfs are made in 2x3 supports (arrows). The 2x3s support the cutoff portion as the blade completes the cut.



An old-time carpenter's method for guiding a power saw for a rough cut—as for house framing cuts—is to grip the shoe firmly between thumb and index finger and ride board edge with finger's second joint.

Making a plunge cut



To make a plunge cut, raise the top guard and start the saw with the front edge of shoe only resting on workpiece. The turning blade is aligned over line to be cut.



All long lines are cut using the circular saw; then either sabre (shown) or keyhole saw completes cutting at corners.



Spinning blade is lowered slowly into the workpiece *without moving forward*. Blade guard can be released once the blade is fully into the work. Next, saw is moved slowly forward until it reaches corner.

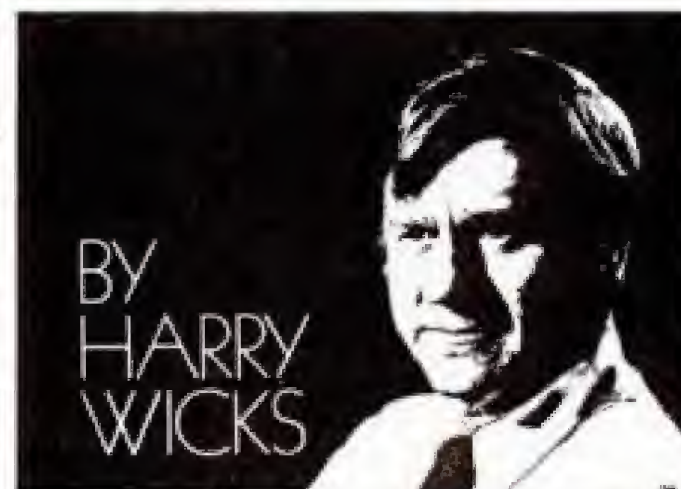


Cutout is clean, neat and safely made. Note that throughout the cutting, the work was fully supported by 2x3s positioned to straddle the line being cut. This prevents the chance of a pinched blade.

plywood, with at least one 2x3 under the smaller cut-off portion.

All support boards should be arranged so they are parallel to the cutting line, and the two closest ones straddling it should be as near the cutting line as possible. The saw should ride on the larger piece and the cutting line must be easy to reach by the operator throughout the cut.

PM



BY
HARRY
WICKS

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av. per cigarette, FTC Report Dec '79

MERIT
Kings & 100's

12 great ways to say Merry

There's sure to be at least one

by Harry Wicks HOME AND SHOP EDITOR

Initiated in 1977, PM's annual roundup of special things to make for Christmas giving has become one of our readers' favorite features. For 1980, we have again selected especially handsome ideas—an even dozen—that are intended to give you great satisfaction when you make them—and even more when you give them to the special people in your life. The color

- 1 Gaily painted horse-on-a-stick is sure to please 3- and 4-year-olds. It is easy to build and will provide hours of fun.
- 2 Humming top is a great project for lathe buffs, and it's sure to become a family heirloom. Of walnut, it hums as it spins.
- 3 Colonial candlestand, finished in mellow pine, is a replica of those in museums and restorations. We help you build it fast.
- 4 Whimsical bread-cutting board is simply a miterbox shaped like a loaf—a sure conversation piece at your next holiday get-together.
- 5 A kiddy trike “like they used to make.” Since most commercial toys are of plastic today, make your child a genuine wooden one.
- 6 The four-board bench was a useful piece of furniture in many Early American homes. Our plans will let you add one to your house.



Christmas

gift among these for each member of your family.



5



4



6



7

7 Bright and cheerful canvas sling chair is styled in the manner of the famous Tinker-toys. Chair is easy to build using hefty dowels.

8 Dad's No. 1 assistant won't be able to resist helping out on the next home-improvement project when he gets these play tools.



8

photographs on these pages will serve as a guide for painting. Complete instructions for building the gifts are on the following pages. The collection of ideas is the best way we know to wish you and yours a very Merry Christmas.

Before you begin construction of any of the items in this roundup, read the how-to instructions and study the art so you understand how the piece goes together. You will note throughout that construction has been kept simple—without sacrificing the craftsman-like quality that each project boasts. This way, you will have ample

- 9** Slats of oak and spacer blocks create this elegant coffee table. Wood is left natural, coated with satin-finish varnish.
- 10** Contemporary mirror is made of pine and spray-painted. A good workshop trick shows how to make it with very little material.
- 11** This cheery clown jumps a "rope" of soda straws when the toy is pulled. It will be a toddler's favorite gift this Christmas.
- 12** Old-time rolling pin is patterned after one found in an antique shop. Like the original, it is fashioned completely out of hardwood.



time to do those projects which appeal to you. No matter which projects you build, allow enough time so that you'll have at least one week before Christmas to apply the paints and finishes correctly.

Except for a couple of projects, you do the majority of the building with low-cost pine and plywood. Use standard methods for working these materials. For all painted and varnished finishes, make certain you prepare adequately, as spelled out below.

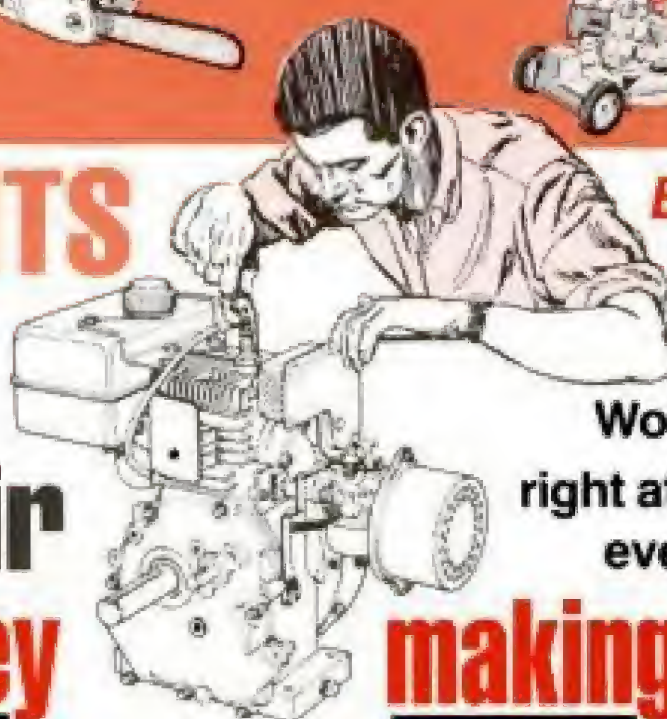
All materials can be cut with

Projects' design and construction: Nos. 1 and 7, C.J. Castelberry and Rosario Capotosto; No. 2, Elma and Willard Walner; Nos. 3, 8, 9, 10 and 12, Harry Wicks; No. 4, Doug Eisman and Harry Wicks; No. 5, Harvard Leighton and Rosario Capotosto; No. 6, Joseph Provey; No. 11, Merton Slutz and Rosario Capotosto; technical art: Eugene Thompson; PM photos: Harry Hartman; styling: Gabe Herrick.





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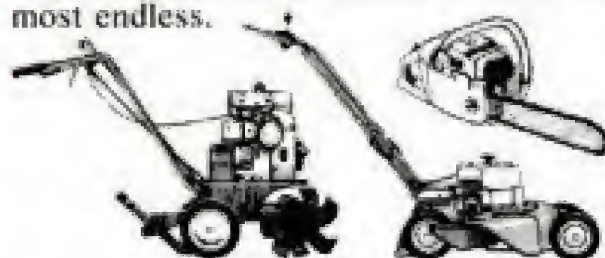
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Christmas Gifts

either portable or stationary power tools—or with a handsaw, if you prefer. All wooden members should be well sanded prior to assembly; finish up the raw wood with 150-grit sandpaper.

Use a minimal amount of either white glue or carpenter's glue for assembly. Always check for glue squeeze-out before staining; use a sharp chisel to remove any hard-

ened glue that you may spot.

For maximum control, use oil stain wherever a natural finish is preferred. This type of stain gives you greater working time, which means you can control depth of shade with less effort.

For durability, we recommend using varnish on the natural pieces. Wipe the workpiece with a tack cloth before applying the finish to obtain a smooth, professional look.

For best results, apply two coats of varnish, rubbing lightly with 180-grit paper between coats. Back up the abrasive paper with a block and carefully dust and tack

off the piece before the final coat.

Because there isn't that much surface to be covered on those projects to be painted, the smartest move is to use one of the sprays in a can. These, when used properly, produce a professional-looking finish. The only exceptions here are the dowel chair and pieces to be decorated (kiddy tri-cycle). These should be painted with a brush.

Note: The materials for all of the projects except the clown pull toy and kids' toolbox are given on the drawings. The two exceptions have materials lists at the end of the how-to instructions

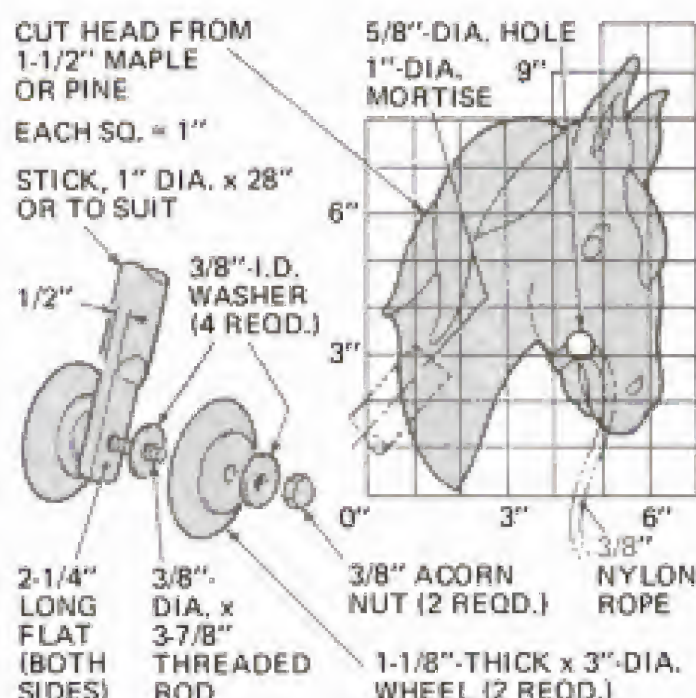
1. Horse-on-a-stick

Make this toy and a favored grandchild can ride off into the sunset, just like grandpa did when he was 3 years old.

1. Cut out the head with a jig- or band-saw. Choice of lumber is optional, although softwood may be preferred.

2. A pair of flats are cut at the bottom of the dowel to make a bearing surface for the wheel assembly. This can be done with the band- or jigsaw, or by hand with a backsaw.

3. The wheels are turned on the lathe or you can order wheels from Love-Built, 2907 Lake Forest Rd., Box 5459, Tahoe City, Calif. 95730. (Send \$1. for catalog.) Use a $\frac{3}{8}$ -in. threaded rod for the axle. Cap the axle with acorn nuts.



7. Cut the bottom of the assembly off the wood faceplate with a turning chisel.

8. Turn the winding peg. Bore the string hole; dowel and glue the peg to the upper portion of the top.

9. Turn the point dowel and glue it to the bottom. Bore a pilot hole in the point tip and tap in a brass escutcheon pin.

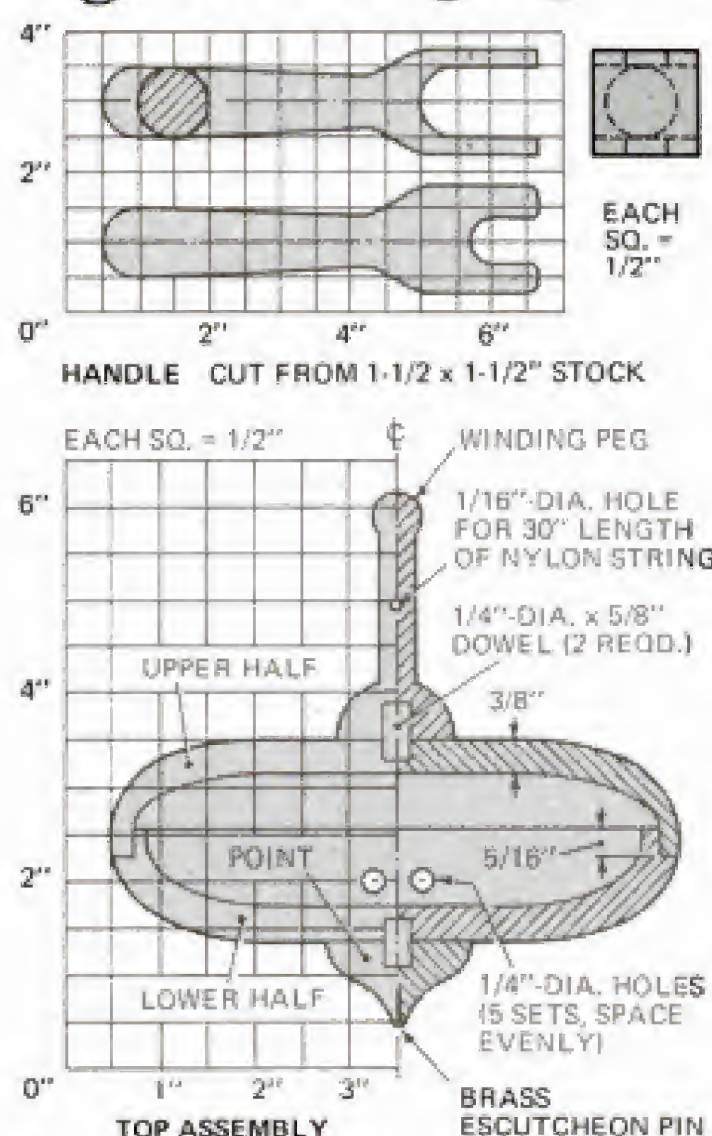
10. Bore the five sets of "hum holes" at previously marked locations.

11. Glue top and bottom together.

12. The spinning handle is 1 1/2-in. turning square stock. Mount it between lathe centers and turn to dimensions given, leaving front end square. Lay out prongs of view A and saw out. Give the square a quarter turn, lay out the prongs of handle (view B) and saw out. Coat top and handle with clear finish.

To spin, use a 30-in. length of nylon fish-line; tie a finger loop in one end. Thread the other end through the hole in the spindle and wrap the cord around the spindle. Slip a finger through the loop and set the top on a smooth floor, holding it between the prongs (B) of the handle. Give a steady pull to get the top spinning. At high speed, there is little sound; it increases with middle speed, then decreases as the lower speed is reached.

2. Humming top



This hollow wooden top spins with a pleasing, low-pitched hum. Its tone is loudest when spinning at medium speed.

1. Make the top of hardwood, turning the walls no thicker than illustrated.

2. Cut two wood circles for the upper and bottom parts of the top about 1/4 in. thicker than finished dimensions given. Glue each circle to a scrap-wood faceplate the same diameter as lathe faceplate.

3. Mount upper top-wood faceplate assembly on the lathe faceplate. Turn the outside to shape, then hollow out the inside. Remove from the lathe faceplate.

4. Mount lower top-wood faceplate assembly on the lathe faceplate. Turn the outside to shape given in diagram. Turn the lip at the edge and hollow out the interior.

5. Check fit of lip into top's upper part. The two should be a friction fit. With the halves together, bring the tailstock against the upper-portion wood faceplate. Turn down the wood faceplate to the diameter of tailstock. Back off the tailstock and complete the turning of the wood faceplate. Bring up the tailstock again to support the assembly and complete any needed turning for a smooth fit at the joint.

6. Use the lathe indexing device to mark locations of the five sets of "hum holes"

3. Candlestand table

Like the four-board bench, the Colonial candlestand was a fixture in the early American home. Its shape was dictated by the available materials and tools, as well as the skill of its maker. Our version is a variation of those in museums and restorations.

1. Start by cutting the pine stock for the top. Mark and bore for dowels and edge-join the boards. Clamp and set aside to dry overnight.

2. If you can get 2 1/2-in.-thick pine stock, this table's pedestal is a good project to use it on. Most likely, though, you will have to glue up two pieces of 1 1/4-in. and one piece of 1/2-in. pine to make up the thickness. Sandwich the thinner stock between the heavier and use glue sparingly on all sur-

(Please turn to page 134)

PHONE WIZARD

DICTOGRAPH® the producer of communication systems for the White House and Pentagon, introduces a space age computer phone. An amazing futuristic instrument capable of 25 functions and memory bank storage of 30 numbers — convenient compact size — all at a price that will make you smile!

No one's got it. And if they do, it's twice the size and triple the price. The Phone Wizard is lightweight (only 15 oz.) and compact, measuring only 8 1/4" x 6" x 1 1/2". The Phone Wizard was selected as the "Most Innovative Electronic Product of the Year" at the recent 1980 International Consumer Electronic Show. All American made, it is approved by the FCC (U.S. Government).

The Phone Wizard is based on a unique 'Logical Language Sequence', which gives each key multiple use. This feature is activated by pressing a predetermined code onto a multiple use key (like a multi-function digital watch).

It's an Automatic Dialer

Think of the number of people you frequently call. The Phone Wizard stores up to 30 often used phone numbers (up to sixteen digits each) in its Memory Bank.

When dialing don't pick up the phone, just push the right button and listen. The built in loud speaker lets you hear the other person answer or the busy signal.

Glance at the big bright LED display. You'll immediately know the right number is being dialed—

More Outstanding Features

- Pressure sensitive keys, solid face (no buttons).
- Beep tones tell you that each digit is being dialed or stored correctly.
- Back-Space Erase lets you 'erase' a wrong number. Easy as pie.
- Want to confirm a stored number? Just press the storage button twice. Instantly you'll see a big read-out so you can verify.
- Automatically rings your number up to six times, then stops when your party isn't home.

Connects to Any Phone System In Minutes

MODULAR PLUG SYSTEMS. Installing the Phone Wizard to any modular plug takes only minutes. Simply unplug line from phone and plug into connection labeled "line". Then plug one end of Phone Wizard cord (included) into connection marked "phone" and the other end back into telephone. Even older platforms require only an inexpensive adapter. This adapter is available at any stereo/radio store and connects in seconds. In addition, Phone Wizard automatically transforms dialer phones to

push button.

INTERNAL PHONE SYSTEMS sometimes require the dialing of 1 or 2 digit excess number to connect with the main system, for recording reasons. With Phone Wizard, you can still store frequently used numbers, and still press only one key for dialing. For example, the excess number is 91. Just press 91. Then press Pause, which allows enough time for internal recording. Then continue pressing the number desired, say 265-829-2112. The LED will display 91P2658292112. Now press Store/Reset and the desired storage position. Instantly, the number is stored for "one-touch" dialing.

PRIVATE PHONE COMPANIES such as SPRINT or MCI are easily used with Phone Wizard. The only difference is that you'll use two memory keys. The first stores the computer access number, for instance, 492-5000. The second stores your authorization number, plus the full number you want memorized. To place the call, press the first key (storing access number), wait for the computer's signal. Then rapidly press the second key TWO times. Now your call is automatically placed.

MULTI-LINE phone systems require an adapter, which is quickly installed. Up to 5 lines can be hooked into the adapter. Or you can connect other phone accessories. Ordering instructions follow.

Busy Number Buster and Emergency Dialer

Suppose the number you're calling is busy, just touch the Re-Dial Key, to recall. Still busy? Just program the Phone Wizard to redial later on (up to 15 times, one per minute). A special sign on the display will indicate that the number is being redialed.

Emergency! Here's the quickest and easiest mechanism for dialing the Police or Fire Dept.

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Activate the One-Way Conference Speaker by depressing a button. Conduct group meetings over the phone. Everyone on your end will hear the phone conversation through Phone Wizard's loudspeaker. You relay ideas and suggestions from the group by speaking through the telephone receiver, and everyone hears the answer. Meet by phone, you'll save time, effort, and not

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Christmas Gifts

(Continued from page 132)

faces to be joined. Clamp the piece securely overnight.

3. After removing the clamps, clean off all glue squeeze-out using a sharp chisel. With a pair of large dividers—or using the string and nail method—lay out the 14-in. circle for the top. Cut it out with band- or sabre saw. Sand the edge smooth with 100-grit paper and round the edges on both sides, using a $\frac{3}{8}$ -in. rounding-over bit in a router. Give the edge a sanding touchup.

4. Lay out the shape for the pedestal (leg) and cut it out using bandsaw or table saw. If cutting with the latter, refer to your saw manual for making taper cuts on the table saw. After cutting taper, notch the top end as shown.

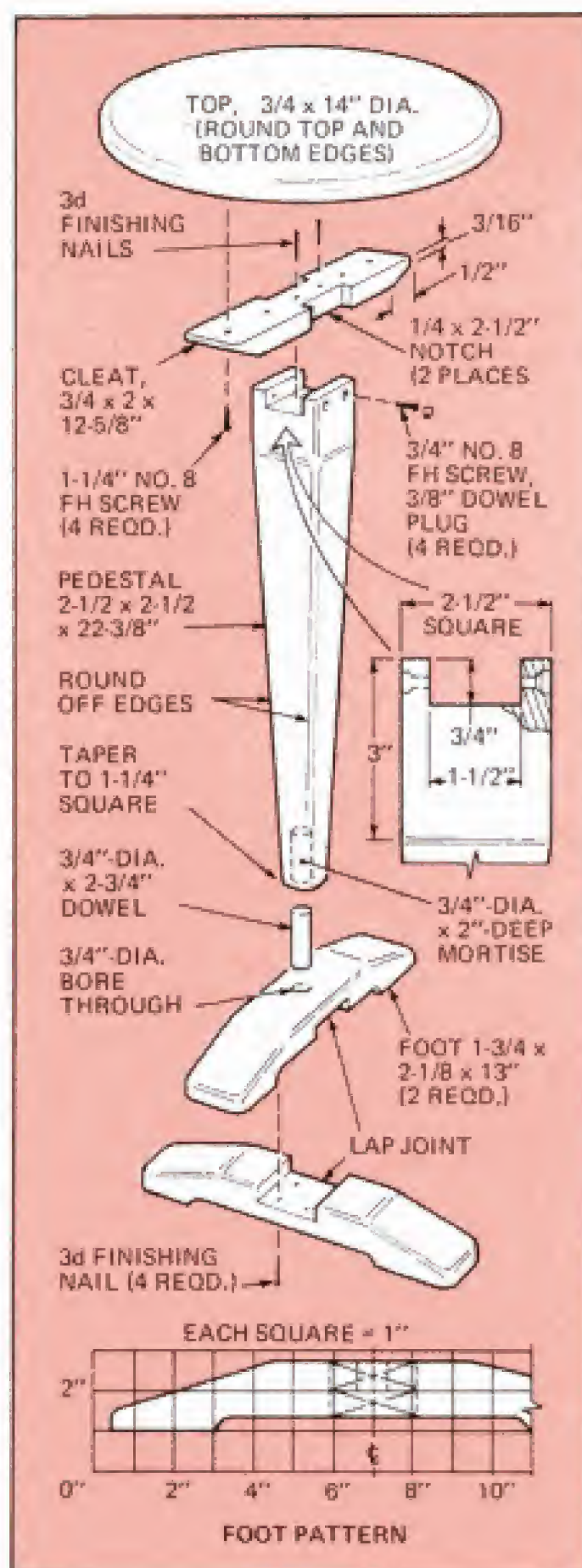
5. Bore the bottom end at the center to receive the $\frac{3}{4}$ -in. dowel which serves as a tenon. The dowel should extend at least $1\frac{1}{4}$ in. into the leg.

6. Cut the cleat and shape as shown in the drawing. Keep in mind that this must fit the leg neatly so check the fit as you construct this cleat.

7. Using the drawing as a guide, cut out the pattern for the feet. Trace this outline on the $1\frac{1}{4}$ -in. stock and cut out the feet.

8. After the feet are shaped, round the edges and sand smooth. Join the feet using glue and small brads. Set aside to dry overnight.

9. Next day, bore the $\frac{3}{4}$ -in. mortise at the foot center to receive the dowel tenon.



10. Because of its shape, the candlestand is almost impossible to smooth once it has been assembled. For this reason, check all the parts for smoothness before proceeding with assembly. Sand where needed and dust off all residue.

11. To assemble, start by gluing cleat into the notch at the top of pedestal. Use glue sparingly and hold the piece secure with three $1\frac{1}{4}$ -in. finishing nails. Bore for and install screws and dowel plugs as shown.

12. Put the top piece (good side down) on a clean work surface and locate the cleat on its bottom surface. With pencil, lightly draw cleat outline and then remove it. Apply glue sparingly to top surface of the cleat and reposition cleat on the top. Drive three $1\frac{1}{4}$ -in. nails through the cleat to hold the setup rigid while you bore pilot holes for the $1\frac{1}{4}$ -in. No. 8 fh screws.

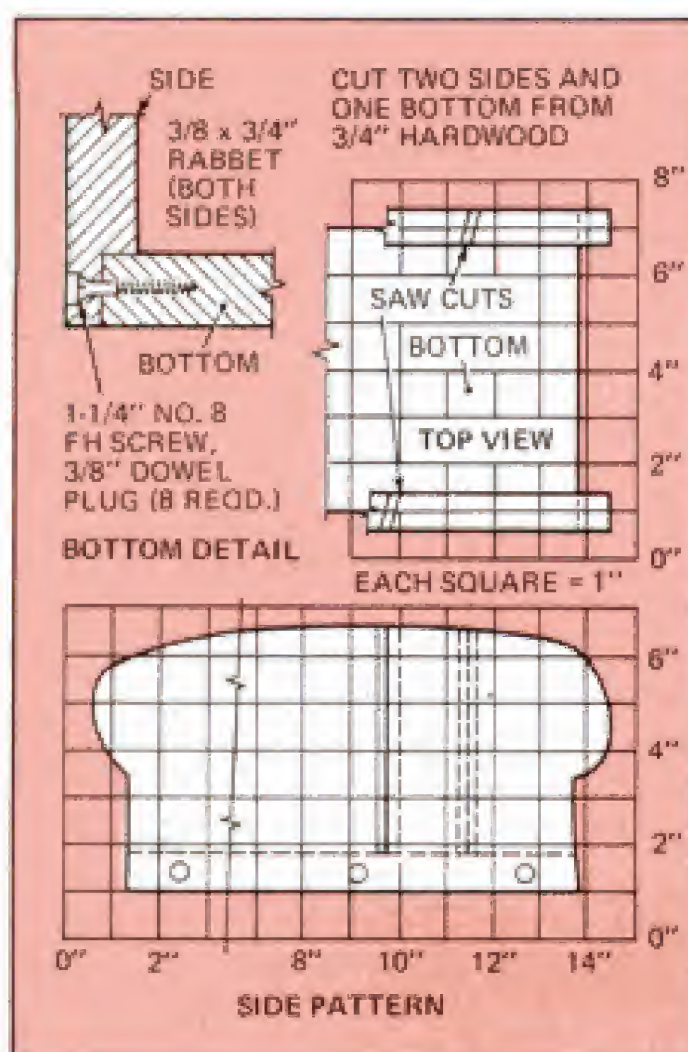
13. Next, apply a small amount of glue to the dowel tenon and insert it into the mortise in the foot. Check to make certain that the leg is square to the floor (feet) and place some weight on the tabletop. Allow assembly to dry overnight.

14. The next day, check all glue lines for squeeze-out and, if you spot any, remove with a sharp chisel.

15. Apply oil stain following the maker's instructions on label. On the stand shown, for a natural pine look, we mixed yellow ochre pigment from a tube with turpentine, a slight amount of boiled linseed oil and a little pine oil stain. (The stain was deliberately kept light.)

If you mix your own, test it first on scrap of the stock with which you built the stand. Apply the stain mixture with a brush, let it set 10 minutes or so and wipe off excess with rags. Set the stand aside to dry 24 hours.

16. Finish with two coats of varnish; for an authentic look use either flat or satin-finish. Sand lightly between coats with 180-grit paper, dust and wipe with a tack cloth.



4. Bread cutting board

This whimsical cutting board is sure to draw comments at your holiday buffet. It can be used with a conventional, saw-type bread knife or, if preferred, you can buy an inexpensive backsaw and use it exclusively for bread.

1. Cut the three boards to size as shown. Edge-rabbit bottom edges of boards (A).

2. On scrap $\frac{1}{8}$ -in. hardboard, plywood or cardboard, draw the loaf of bread outline following the drawing.

3. When you're satisfied with the shape, transfer it to the boards (A).

4. Tape both parts (A) together and cut them out at one time using jig- or bandsaw.

5. Sand all edges and surfaces smooth.

6. Assemble the miterbox using screws in counterbored holes. Put a dab of white glue in each hole and insert the dowel plugs.

7. Clamp the box in a vise and, with a fine

crosscut saw, carefully make a miter cut down both sides (to the top surface of the bottom piece).

8. Finish the box with two coats of Salad Bowl Finish. (See Rolling Pin directions for source.)

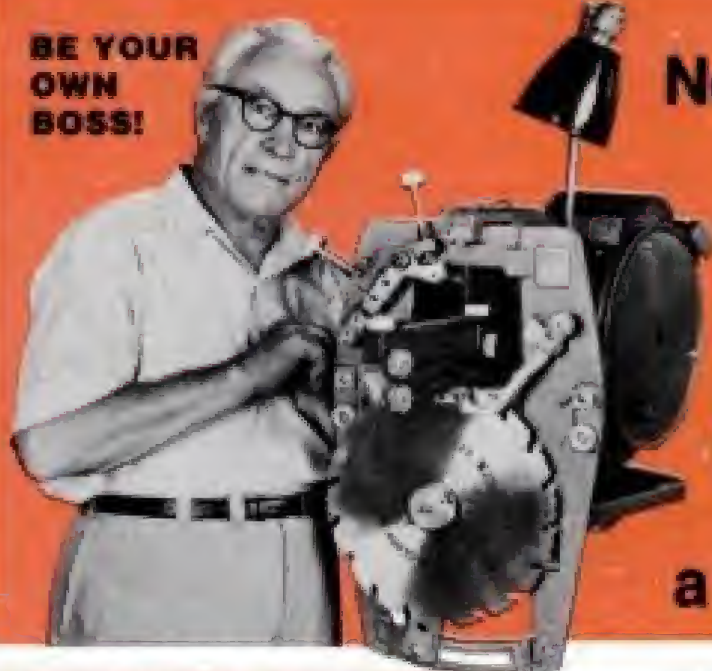
5. Kiddy tricycle

This project requires just moderate workshop skills and toddlers will delight in using it. The original, from which this was copied, was finished with enamel and it endured for two generations of use.

1. Using the drawing as a guide, lay out the seat, seat support, rear support, backrest and wheel on plywood. Cut parts out using a sabre saw. Fill edge voids where necessary and sand all edges smooth.

(Please turn to page 136)

**BE YOUR
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BOSS!**



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"I worked in various industrial jobs for years, and always wondered if I could make money for someone else, why I couldn't do it for myself. So after losing my regular job, I opened my Foley sharpening shop in the basement of my home. I only had a minimum of cash to start with, but Foley financed the balance. My shop will gross over \$40,000 this year, and I like the feeling of running my own shop without answering to someone else."

**William Wescott
Willoughby, Ohio 44094**



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wife have a
going spare
time shop**

"I'm a construction foreman, and my wife is a nurse's aide. Our Foley shop fits in nicely with our regular jobs, and we earn extra money. Our sons help out too, so ours is a real family business."

"I'm still too young to retire, but when I do I'll have a very good business built up. Foley equipment helps us to do good work and brings customers back with more jobs on a regular basis... we have a lot of repeat business the year around."

**Victor Kosloski
Sturgis, Michigan 49091**



**Glad he
chose Foley
for his saw
shop**

"I worked as a carpenter all my life, but when a back injury forced me to quit I decided to go into sharpening full time. I'm very proud of my shop and glad my choice was Foley equipment... it is superb. I made over \$48,000 last year, and this year it will go more than \$50,000."

**Victor Johnson
Lincoln, Nebraska 68507**

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Owning your own business brings you a sense of independence. You're the boss, setting your own work hours. Your own effort builds the business for yourself and your family. You can achieve great satisfaction and profits, if you choose and manage your business wisely. That's why so many men, just like you, are cashing in on the big profits to be made in this fast-growing service field.

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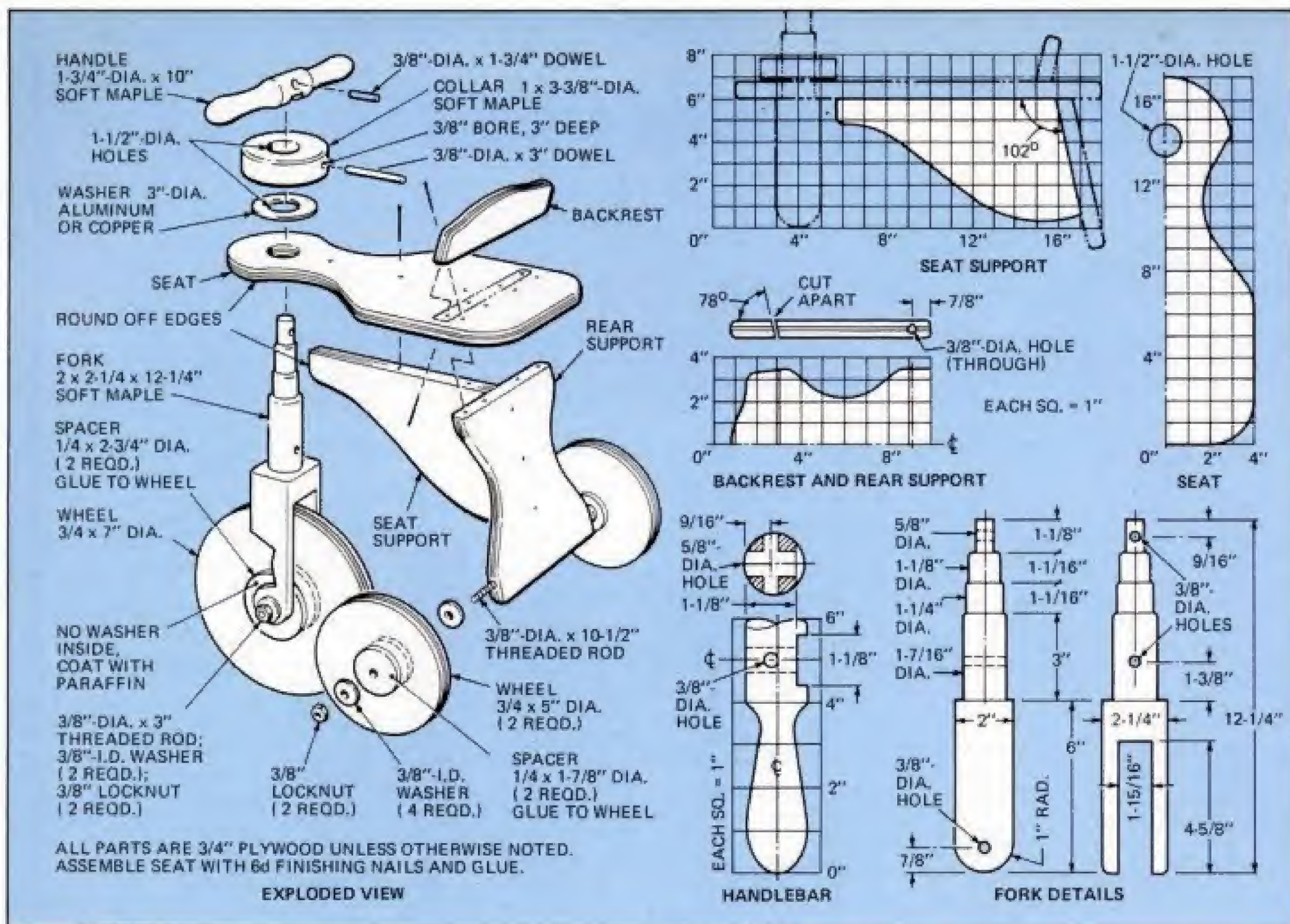
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(Continued from page 134)

2. Cut maple stock for the fork to size. Mount in lathe and turn shank as shown. Scribe semicircle on square end and drill 3/8-in. hole on center. Cut out semicircle and slot.

3. Next, mount the blank for the handlebar in the lathe and turn that piece. Remove from lathe and bore the mortise to receive the tenon. (The second hole for pinning the handlebar to the fork is bored after these parts are assembled.) Turn the hardwood washer.

4. Assemble all the parts dry to check for fit. Disassemble and adjust dimensions if necessary.

5. When you're satisfied with the fit of all parts, reassemble the tricycle—using glue and hardware—as shown in the drawing.

Note: Make certain you nail-fasten the rear support before installing the backrest. If you reverse the procedure, you won't be able to drive the nails through the top and into the support.

6. Apply a coat of primer to the tricycle and allow it to dry overnight. Next day, finish with enamels using the color photo as your guide.

Note: If there is any possibility of a child chewing on the toy, use only leadfree non-toxic paints to finish.



After turning the fork on the lathe, slot for the wheel is cut out on the bandsaw.



Fork is held on trike by tapping a 3/8-in. dowel through collar and into the fork.

6. Four-board bench

It is almost impossible to visit a recreated Colonial village or a museum without seeing at least several versions of the four- and five-board benches that were so popular with the early settlers. As the name implies, the simple benches are assembled using a certain number of boards: The four-board type features a stretcher between legs, while the five-board eliminates the stretcher and adds a pair of skirts directly below the top board.

The PM version was created by the author after visiting many restorations and studying countless numbers of such benches.

1. Rip the 3/4-in. stock to necessary widths and plane the edges to be joined.

2. Join boards to create the widths necessary for top and legs using dowels and glue. Do the same to create the thick board for the stretcher.

3. Clamp the glued-up pieces securely and allow them to dry overnight.

4. Trace the patterns for the legs onto a piece of 1/4-in.-plywood scrap; when satisfied with shape, cut it out using a band- or sabre saw. Sand pattern edges smooth.

(Please turn to page 170)

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Audi	Crickit	124 Spyder,	Morris Minor	Subaru
Austin	Crosley	500, 1100,	Mustang	Sunbeam
Austin-Healey	Daimler	1200, 1500	Mustang II	Sunbird
Beetle	Datsun 240Z,	Convertible	Omni	Tiger
BMW	260Z	Fiesta	Opel	Triumph exc.
Bobcat	Datsun 280Z,	Fox	Pacer	Spiritfire, TR2,
Capri	280 ZX	Gremlin	Pinto	TR3, TR3A
Celica	Datsun 1200	Hillman-Minx	Porsche	Vauxhall
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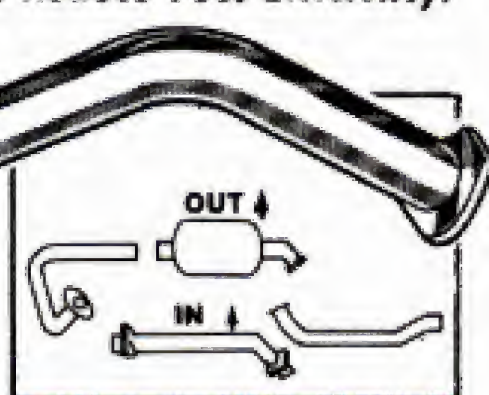
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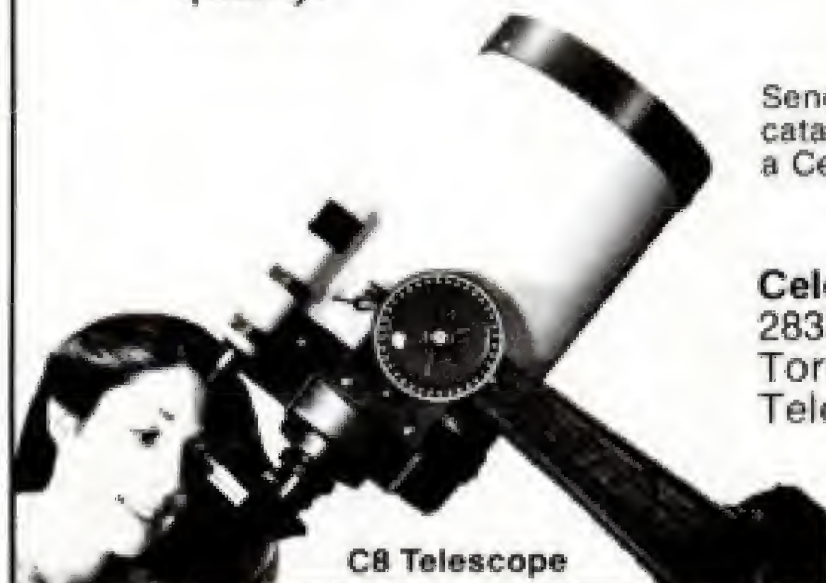


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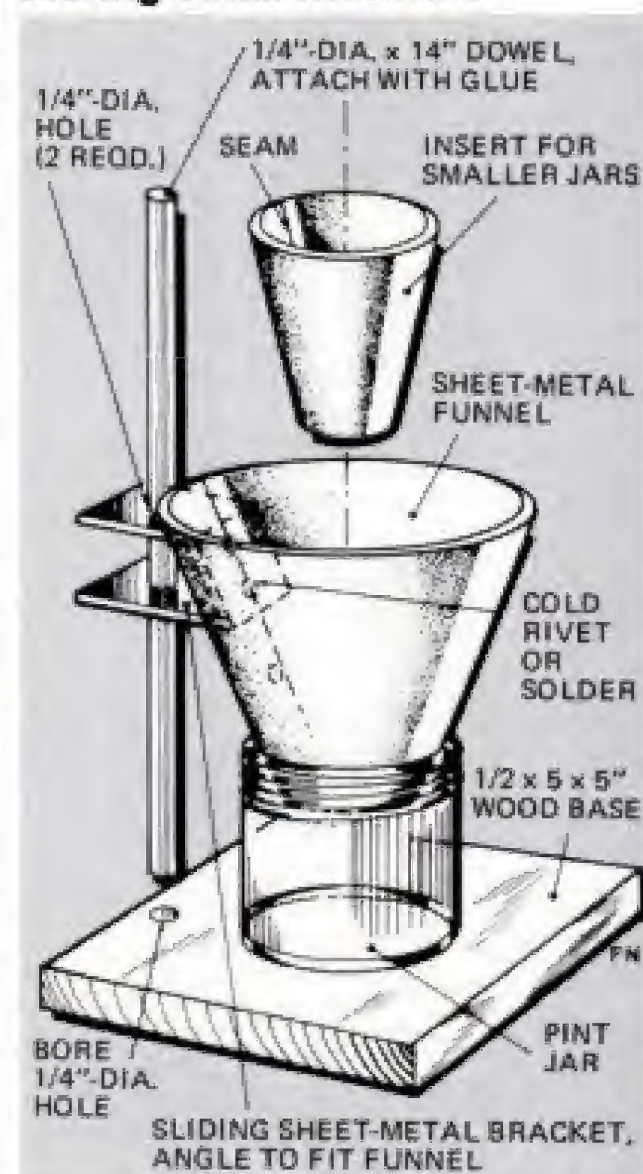
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An indoor-outdoor thermometer taped to a refrigerator lets you check the interior temperature. Route the capillary tube through the door gasket. —Gerald Zuhlke

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Most major companies would rather have these facts remain secret, but one little-known company decided to show its genius to the world.

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One company that has been the real source behind products introduced in the U.S. by companies like Mattel, Timex and Texas Instruments, is Olympus Electronic Co., also known as Otron.

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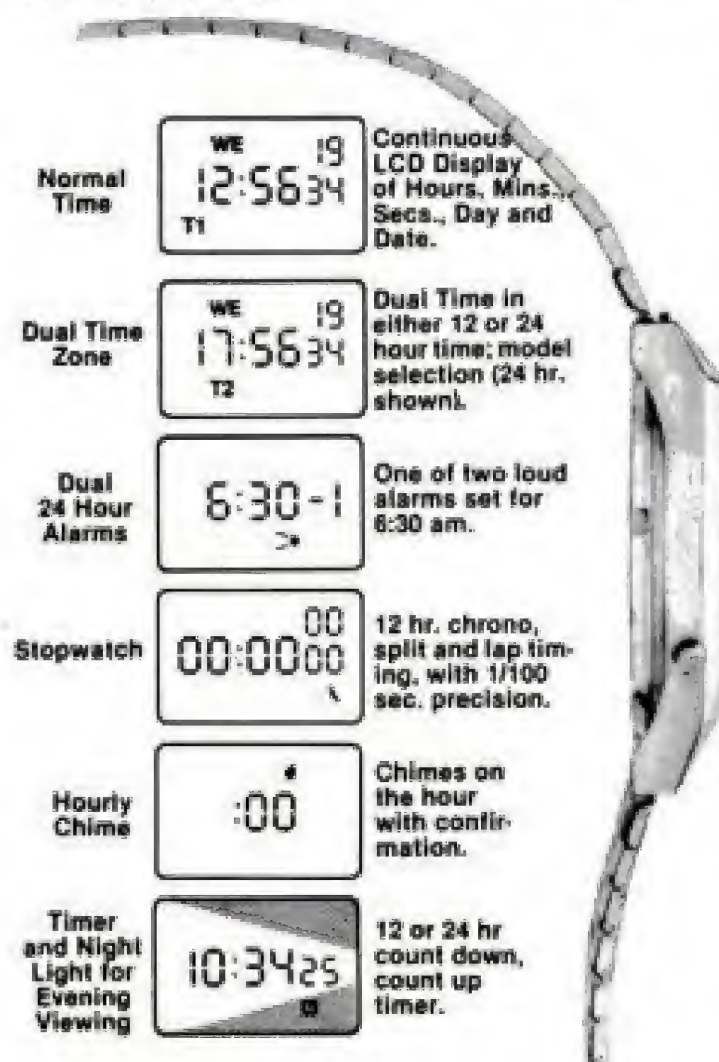
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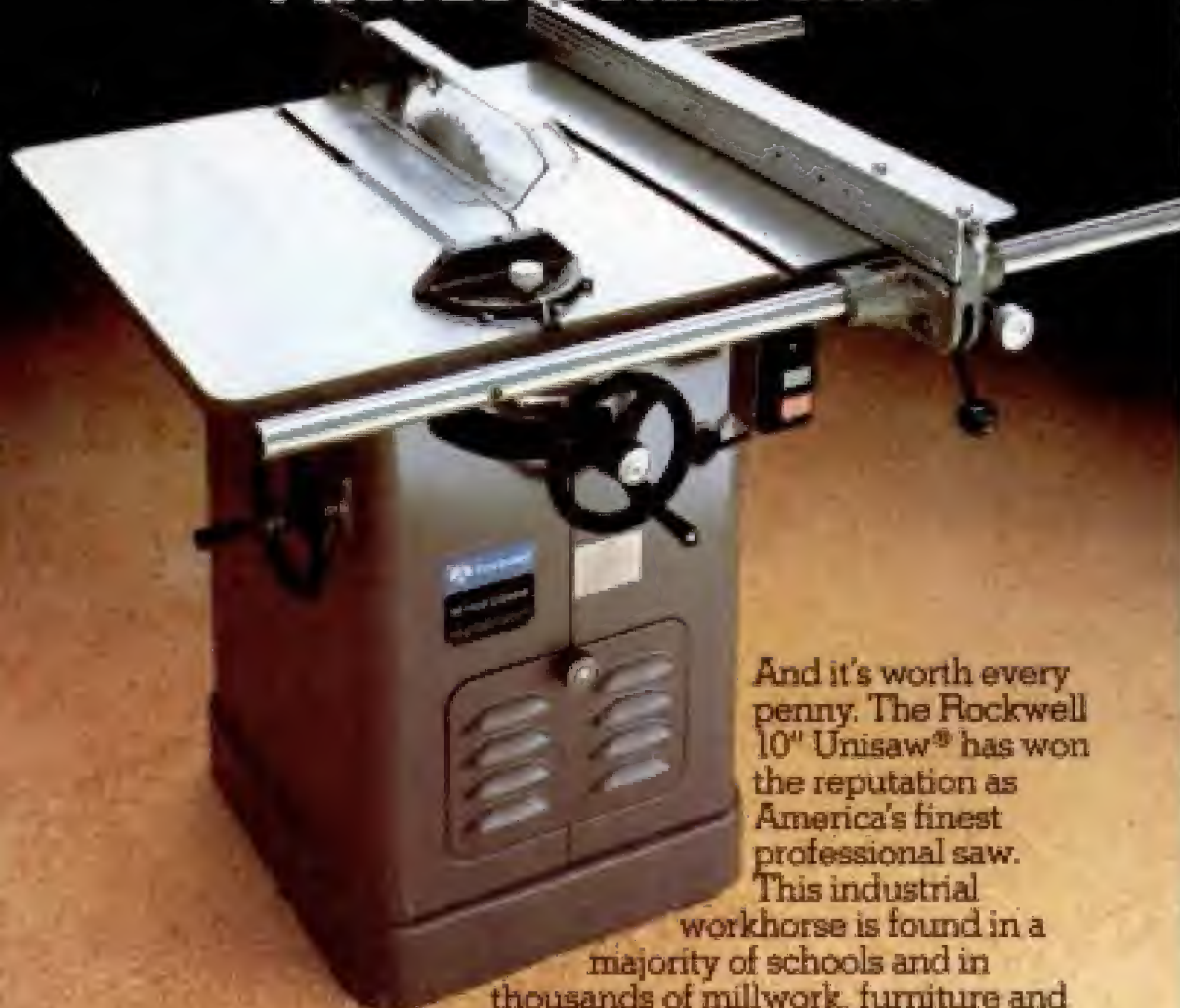
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drink, the lakes you swim in, and even rain itself, can be more radioactive than a nuclear reactor's main-condenser coolant water, which, surprisingly, falls within public drinking-water standards. Much of the food you consume is radioactive from naturally occurring radioactive forms of carbon, hydrogen, potassium and radium. Brazil nuts are particularly radioactive. Even the milk, beer and whiskey you may drink are naturally radioactive. And if you want the whole ghastly truth, *you* are radioactive. What's more, if you sleep in a double bed with someone, you get zapped by his or her personal radioactivity every night, and vice versa.

Two kinds of radiation

Besides all such *natural* "background" radiation, there is the man-made variety. By far the most potent source in that category is medical technology (see illustration on page 91). There are two basic kinds of radiation: ionizing (which includes everything mentioned so far) and nonionizing. The first is a natural process in which unstable atoms of substances like uranium emit particles of their nuclei, or central core, releasing energy as they break away. Nonionizing radiation is produced by high-frequency phenomena like microwaves, including radar.

The ionizing type is involved in most of the bitter controversy today, and is the focus of this article. Even it comes in different forms, depending on the nuclear particles emitted: Most common are alpha, beta, gamma and X-rays. Each of these rays has its own characteristics and penetrating capability. Alpha and beta wave/particles, while heavily damaging to human tissue, are readily stopped by a few inches of air, a sheet of paper, or foil. Gamma and X-rays, on the

WHAT WE KNOW ABOUT RADIATION

(Continued from page 91)

tional light on quantitative dose-response relationships." That, in itself, was an important finding, the Research Council went on, because of the public's "heightened sensitivity to the potential dangers of radiation." In other words, there is at least a 50-50 chance that no news is good news.

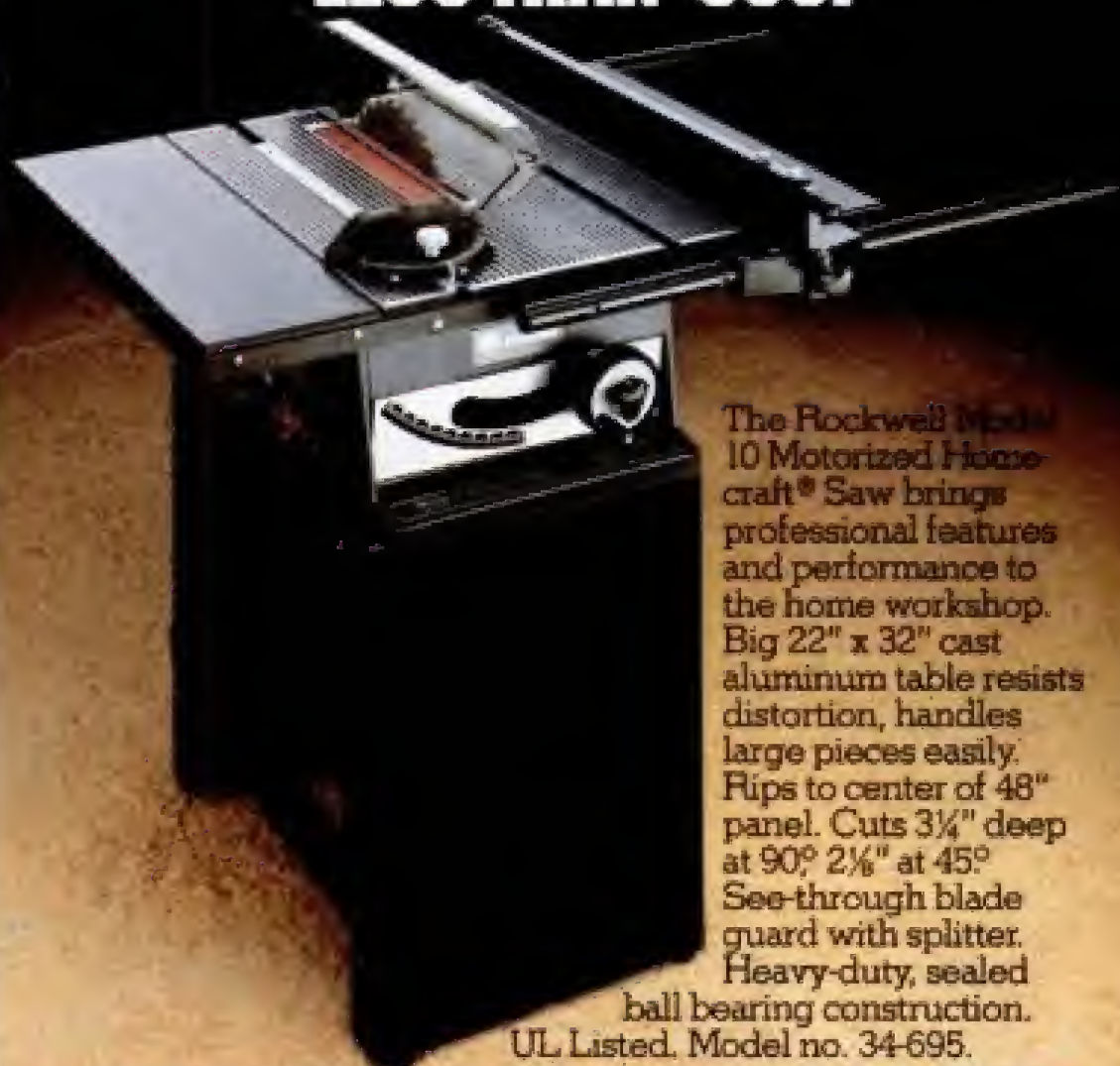
Adding to the confusion is a vague impression on the part of many people that radioactivity is a relatively new hazard, brought on by nuclear weapons, fallout, reactors and their waste products.

Zapped consistently

The hard fact is that since humans first appeared on Earth we have been zapped by constant and unremitting radiation—from conception to the grave. E. David Harward, Environmental Projects Manager for the Atomic Industrial Forum, told *Popular Mechanics* recently: "Unfortunately, most people just do not understand that we live in a smog of radiation."

Cosmic rays from outer space and intense radiation from solar activity bombard us continually. In addition, there are highly radioactive materials all around us that were formed when the Earth was created. The air you breathe is radioactive, due to the presence of radon gas, a decomposition product of the uranium present in everyday things wherever you turn. Walk down a city street or country lane and you're zapped by naturally occurring radioactive elements such as uranium, thorium and radium in the rocks, soil and masonry (like Grand Central's granite walls). The house you live in is radioactive—more so if it's brick or stone than if it's wood. Some of the well water you

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other hand, are somewhat less damaging, but can pass through thick concrete without attenuation.

A radiation dose is measured in "rems," an acronym for Roentgen Equivalent Man, a unit representing a rate, as "miles per hour" is to speed. It equates the types of rays and the amount of energy they deliver, specifically to human reproductive tissue. Most background sources produce a level of radiation considerably lower than one rem, however. So most of the measurements you see will be expressed in units a thousand times smaller, called millirems, and written "mrems." For example, the average radiation dose received from the natural environment by each person annually in the United States is about 102 mrems, or a little more than one-tenth of a rem. Add to that the dose from medical and other man-made sources, and the annual zap for the average American comes to about 200 mrems.

Stronger doses at altitude

But that's not the end of it; those are just averages. As indicated on the illustration on page 91, a large part of natural radiation is "cosmic" in origin, passing through Earth's atmospheric envelope from space. These particles bombard humans living at sea level with 35 to 50 mrems per year, depending on things such as sunspot activity, solar flares and changes in Earth's magnetic field. But the amount of cosmic radiation you soak up depends on where you live. The higher up, the higher your cosmic dose. If you live in Miami, cosmic rays shower you with 35 mrems per year; in mile-high Denver you get more than 120.

"If you climb a mountain," David Harward points out, "you increase the dose you get by one to two mrems per year for every hundred feet you go. At 1000

feet altitude, you're irradiated by an extra 14 to 20 mrems per year, depending on latitude and other factors. At 8000 feet altitude, you're up some additional 150 mrems annually. If you had an office on the 100th floor of the John Hancock Building in Chicago, you'd increase your cosmic ray exposure by a rate of some 20 mrems per year."

Natural radiation from terrestrial sources can also vary widely, depending on how and where people live. A family living in a home built largely of granitic fieldstone, or of concrete block made from mill tailings, fly ash or cinders, would receive about 50 additional mrems each year if only three-quarters of their time was spent in the building. A wood frame house exposes its occupants to 35 mrems per year.

"One of the culprits," explains David Harward, "is radon—that natural gas in all soil, water and air. It has a 3.8-day half-life, producing two isotopes that concern us in its decay from trace amounts of uranium. It is present in many building materials, including gypsum products, things made of fly ash, and so on. Ironically, insulating and tightening up a home to increase its energy efficiency also increases the radon level within the structure. You get a surprising amount of radiation from a solar heat-collecting rock bin, for instance."

There is also considerable radioactivity in most fossil fuels. "Total radiation from coal," Harward points out, "may exceed that from nuclear power plants in normal operations. It is remarkably higher in and around old coal plants. The worst we've ever found was an old coal-fired power plant which had a much higher total radioactivity reading than any nuclear plant in existence."

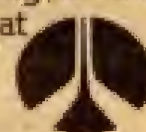
(Please turn to page 142)

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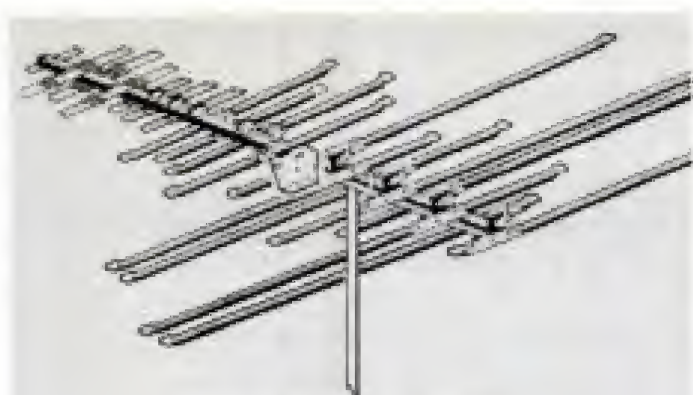


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WHAT WE KNOW ABOUT RADIATION

(Continued from page 141)

As for radon and other radioactive atoms in the lakes, streams and underground springs from which we get our home water supplies, from the plants and animals comprising our food sources, and from the air we breathe, add another 25 mrem per year. If you're on a well supply containing elevated radium levels, like many in the United States, you get a substantial dose with every shower you take.

Nuclear energy

The *man-made* radiation to which humans are exposed comprises less than a third of the total. People living within 50 miles of a nuclear power plant will receive, on average, between three thousandths and a hundredth of one mrem per year. That's why, when xenon and krypton gas rated at 70 mrem escaped from the Three Mile Island reactor, scientists noted that people living in Denver were, because of their altitude, exposed to the same or an additional amount in the course of normal living at 5000 feet up.

Averaged for all Americans, including radiation workers, the entire normal nuclear fuel cycle appears to add some 0.2 mrem per person per year. Under new EPA standards, which recently cut some exposure limits up to 20 times, people living within 50 miles of a nuclear facility are now limited to 25 mrem per year from that source alone. Radiation workers are allowed to receive up to 5000 mrem per year in normal operations, 12,000 in special circumstances and 25,000 in a "once-in-a-lifetime" crisis situation.

Many other man-made sources expose people to more radioactivity than the existing nuclear cycle. A person who watches color TV an average of one hour a day picks up as much as one mrem per year. There is measurable radiation from any number of consumer products, including fluorescent lights, smoke detectors, luminous dial clocks and watches. In one recent instance, a nuclear plant worker was getting much higher readings on his monitoring badge than other workers in the compound. Puzzled medics investigated and found that he was removing the badge at bedtime every night and putting it atop an electric alarm clock with a luminous dial. "Luminous clock dials we checked in one surplus store," Harward reports, "produced from two to five mrem per hour, measured at the dial."

Glassware and ceramics are fre-

quently quite radioactive. "I remember an unusually high reading from one lady's orange-colored pottery dish," says Harward. "Lab analysis showed that the glaze was made from uranium oxide. There's uranium in certain glass products such as iridescent, fluorescent and ophthalmic varieties, and in many oxide glazes used on ceramics. They can radiate 4 to 25 mrem per year.

"If you have porcelain dentures, they're probably quite radioactive. There are uranium salts in porcelain teeth and crowns. The salts give the dentures their natural color in daylight or artificial light. It makes them realistic all right, but they can provide a dose of up to 1500 mrem per year to gum tissues."

An item that hasn't been extensively aired is the fact that tobacco is radioactive. "There's polonium 210 in tobacco," Harward reveals. "It can deliver up to 8000 mrem per year to heavy smokers."

Less radiation on an SST?

Since jet planes fly five or more miles high, passengers flying from California to New York pick up five mrem from cosmic rays during a round trip, according to the EPA. Crews assigned that run for 600 hours of flight time collect about 500 mrem per year. What about the SST that flies even higher? Since it flies much faster, exposure time is less. Hence, the dose for a transatlantic crossing is less than it would be by conventional jet: about two mrem per trip for passengers; 1000 mrem per year for crew on the regular run.

The EPA research points out that SSTs could be equipped with radiation detectors that would sound an alarm when intense solar flares boosted the cosmic background significantly: "The pilot could decrease his altitude until a safe radiation level was reached."

While medical radiation today is being reduced substantially by improvements in equipment, it still provides the highest proportion of man-made exposure. A chest X-ray with present standard equipment accounts for 50 mrem. Newer equipment will deliver as little as nine mrem. But a single X-ray of the abdomen delivers 210 mrem, more radiation by quite a margin than most people receive in a whole year. Cardiac pacemakers expose surrounding tissues to doses of up to 5000 mrem per year.

Most of the commercial exploitation of radiation devices by outright

quacks has, however, been largely eliminated in this country. Huge doses were once produced by foot fluoroscopes used by salesmen in shoestores. These emitted a continuous X-ray from beneath the foot. The customer put his foot on the emitter and saw a picture of his foot bones. Meanwhile, the customer's reproductive organs and other tissues were being sprayed by the continuous beam!

Radiation rip-off

"Owners of old mines once advertised cures for gout, arthritis and other ailments," Harward recalls, "by bathing customers in pools radiating radon. Most are now prohibited from advertising—one pitchblende mine in Texas used to sit customers on benches, radiate them, and charge them rip-off prices for cures for almost anything."

What does all this mean in terms of health effects from radiation? The kinds of harm that radiation produces in specific heavy doses and short time frames is well documented. A jolt of 200,000 mrem (200 rems) delivered in a few minutes brings on nausea, vomiting and diarrhea, followed by lassitude and irritability. But symptoms pass in a week or two, and recovery is usually complete. A 500,000 mrem (500 rem) dose in a few minutes produces the same symptoms more acutely, and half the victims will die within two months. Doses larger than that, delivered quickly, produce death for all—the quicker the dosage is administered, the sooner the fatalities occur.

Delayed reactions

But if the same large doses are delivered a little at a time over a period of a year, there would probably be no immediate fatalities and few if any immediate symptoms. But delayed reactions would include increased incidence of potentially fatal cancer and chromosomal damage that could later produce some hereditary defects.

In smaller doses generated from low-level radiation—according to the American Nuclear Society—"it can be confidently stated: Individuals who receive less than about 1000 mrem of radiation in a year show no harmful biological effects. Individuals who absorb less than 50,000 mrem in a normal life span also display no clinically observable effects..."

Yet studies have been conducted which appear to indicate high inci-

dences of cancer resulting from low-level radiation of man-made types, such as that inside nuclear facilities and from medical technology. But these general indications have so far not been confirmed by specific follow-up studies—such as one recent attempt to link leukemia patients to higher than average levels of X-ray exposure, in which no correlation was established.

Nuclear proponents decry any study results based on a linear hypothesis. "It's a highly conservative system," claims Harward, "that says for every bit of increased radiation you get anywhere, you get more cancer effects in the total population. It's like saying that if a person drinks 50 martinis at once he will die and, therefore, if 50 people drink one martini each, one of them will die."

But nobody, not even the most fervent supporter of expanded nuclear power, could argue that even small amounts of man-made radiation can just be casually thrown in and added to the large God-given amounts we must live with.

Keeping a low profile

"The most sensible idea," says Harward, "is to keep as low an exposure as possible. Avoid increases unless there's a benefit. There is nothing in this world that is risk-free. Some sources can and should be reduced if substitute materials will serve as well. Phosphates and mill tailings, for instance, do not have to be used in homes. Other materials less radioactive are available. All of life is made up of trade-offs—and that's what should be at issue here."

This article has indicated the kinds of trade-offs that people may make every day in passively accepting nominal amounts of increased radiation from certain sources, and actively rejecting others that could ultimately offer less cumulative exposure. It's up to the individual, but doubtless few of us will try to go all the way and remain in a lead-lined capsule at sea level for our entire lives.

A few years back, when one scientist believed he had isolated cosmic radiation as the primary cause of the aging process—and some relationship may indeed exist—he was asked if there was any way to avoid this dangerous exposure to radiation.

"Yes," said the researcher, himself well along in years. "Don't get born."

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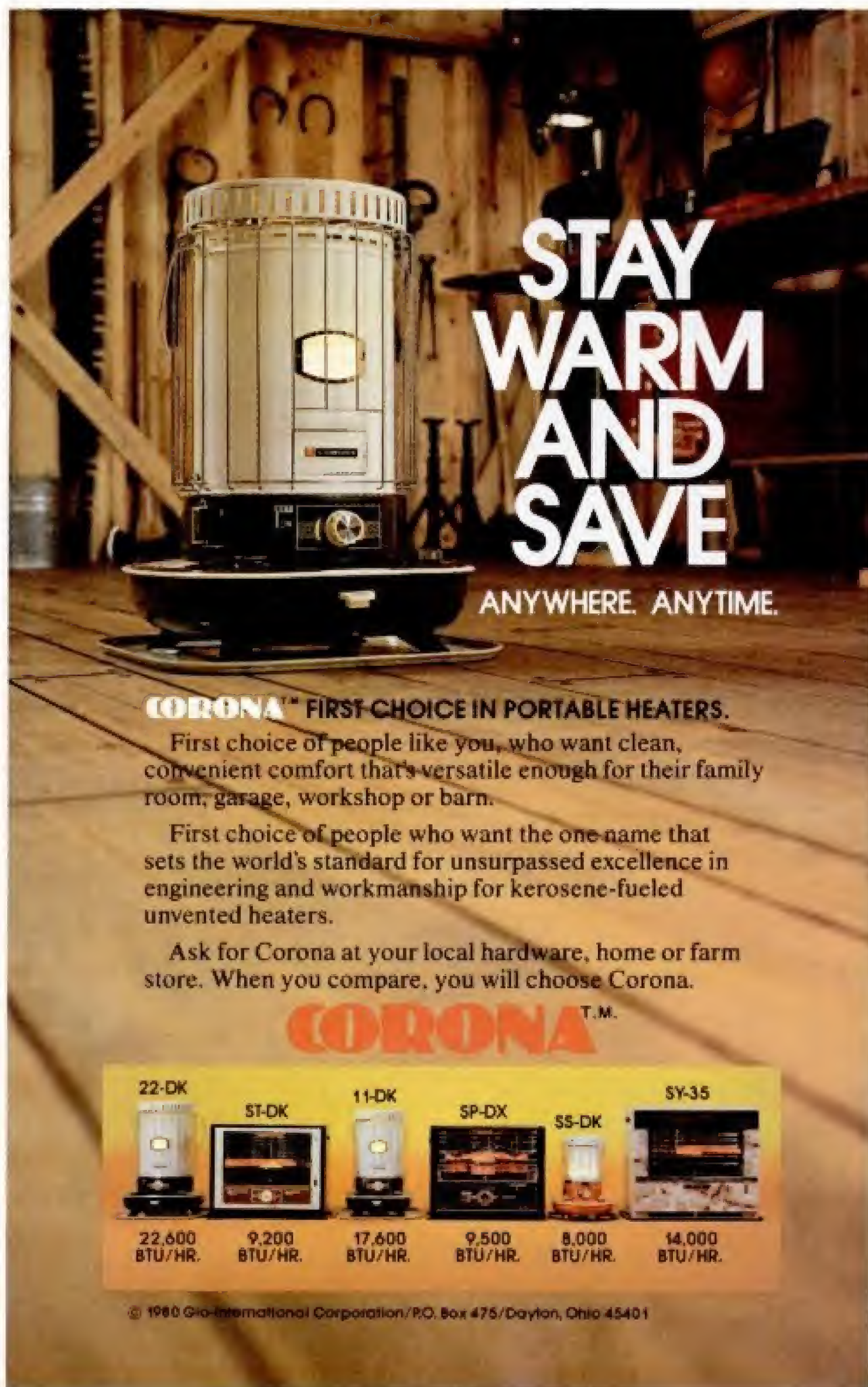
tant when it comes to picking out a pickup. Which is why we suggest you talk to your GMC dealer about buying or leasing one.

Remember: Compare the boxed EPA estimated mpg to the estimated mpg of other trucks. You may get different mileage and range depending on how fast you drive, weather conditions and trip length. Actual highway mileage and range will probably be less than the estimated highway fuel economy. Range estimates are obtained by multiplying the available fuel tank capacity in gallons by the EPA and highway estimates. Estimates and

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SIDE-BY-SIDECAR

(Continued from page 95)

when slowing. (Sidecars are always attached to the right side of a motorcycle.) The three-wheel rigs will also exhibit low-speed wobble (particularly on the Honda Gold Wing). These troubles can often be cured with some changes to the bike. A sidecar manufacturer can recommend the modifications you'll need to make. Usually, a slight extension of the front forks and the installation of rear-end, heavy-duty shock absorbers can take care of many of the handling difficulties.

Installation is simple in most cases. Most sidecars have at least four brackets between the rig and the motorcycle. The top two are mounted as high as possible on the motorcycle frame and the bottom two as low as possible. These brackets are always bolted in place, never welded. Sidecar makers strongly recommend that you never attach a sidecar to a cycle's swing arm or shock absorber.

Some of the flexi-type sidecar arrangements use tube-and-roller setups on the rear portion of the sidecar, but these units also bolt easily to the motorcycle frame. Usually, nothing besides bolting and some minor electrical work is necessary to completely hook a sidecar to a large-bore motorcycle.

In the case of the flexis, some minor air-hose work may be necessary in order to complete the adjustable air-shock mechanism. But for the majority of sidecars, the installation takes only a few hours. And you can remove a sidecar in a matter of minutes. Air caps on the front forks and new rear shocks (if the bike has a few thousand miles on it) are usually recommended modifications to the motorcycle itself. In the past, the very rigid sidecar frames necessitated a strengthening of the motorcycle frame by welding gussets at the joints. But this is no longer necessary because of the high strength and quality of the modern motorcycle chassis.

Different riding technique

Driving a sidecar rig is a different world from riding a motorcycle. Except for the few flexi models, sidecars are made to remain at a 90° angle to the ground. This means that the experienced motorcycle rider, accustomed to leaning his cycle into a turn rather than turning the handlebars, is in for a big surprise.

The sidecar rig must be turned, and this requires a lot more effort and strength than might be expected. There is, however, a feeling of se-

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curity in a sidecar rig, mainly due to the fact that the machine can't turn over. But that feeling of security is tempered by the new and sometimes shocking experience of leaning with all your weight and might, and getting no reaction from your three-wheel rig.

It is important to remember that a sidecar will go where you point it, but you have to point it to get a reaction. You can't lean it. After half an hour or so of practice, you should begin to get the feel of it, and the sidecar will become as much fun as any small sporting automobile. It is just as nimble, and responds quicker than a car in most circumstances. With most large modern motorcycles now coming equipped with disc brakes, stopping the sidecar rig takes only a little more thought and time than stopping a "solo" setup.

Once you get over your introduction to driving the rig, you can begin to appreciate the safety factors of a sidecar. You can't tip over, unless you do something really crazy, and you can ride over any terrain, including sand, loose dirt and even ice and snow, with a new courage and a larger margin of safety.

Forgiving in a crash

Sidecars are forgiving in a crash situation, and let you retain more control than on a solo motorcycle. Sidecar rigs are also much more noticeable to the car driver, and therefore make you safer on the road.

Before you rush off and buy a sidecar, there are a few things you should be aware of. First of all, a sidecar mounted on your cycle may void the bike's warranty. Most motorcycle manufacturers stay away from recommending type of sidecar and have a blanket policy of simply voiding warranties.

The only motorcycle manufacturer that currently offers a sidecar and bike package is Harley Davidson. Their Classic Sidecar is the Cadillac of sidecars and the package sells for about \$8000.

If you're considering buying a sidecar, make sure that it offers some sort of crash protection. This should be in the form of steel tubing around the front and side of the rig. Also make sure there are mountings for brake and signal lights.

Lastly, don't overburden a small-displacement bike with a large sidecar. Get one that's made for your size of bike. A mismatched bike and sidecar will be a beast to maneuver and totally throw off the handling.

Information on sidecars is readily available from United Sidecar Assn., 1621 Palomino Lane, Kingwood, Tex. 77339. **FM**



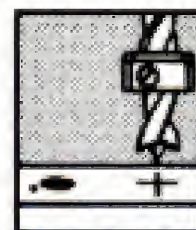
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GREAT SHOP

(Continued from page 111)

noise created within. The floor and ceiling joists are treated with 1½-in.-thick Styrofoam to complete the soundproofing. As mentioned earlier, he also mounts all tool motors on Styrofoam to minimize noise.

A talented, mechanically minded man all his life, the young John Opfer operated his first power shovel at the tender age of 12 (his dad owned the business then).

"I fell in love with the power equipment and all things mechanical as early as I can remember," says John. He can't recall any attitude other than trying to figure out how and why something works, and then deciding whether or not he could do something to improve it.

During the year of his baptism in the heavy-equipment business, Opfer built his first shop (in a separate building that he erected) and purchased his first power tool—a wood lathe. He admits unabashed pride in the fact that "I earned every cent myself to build and equip that shop." From that day to this, he says he has been "learning how to be a craftsman."

Comparing problem-solving

"I'll never have all the answers," he says, "but I do learn a great deal from magazines like *Popular Mechanics*." He especially likes to read readers' solutions to problems similar to his own. "It is fun to see how someone else solved the same problem that I had to solve."

Opfer's workshop is loaded with smart ideas—many more than we could list in this space. With his consent, however, we did zero in on

(Please turn to page 166)

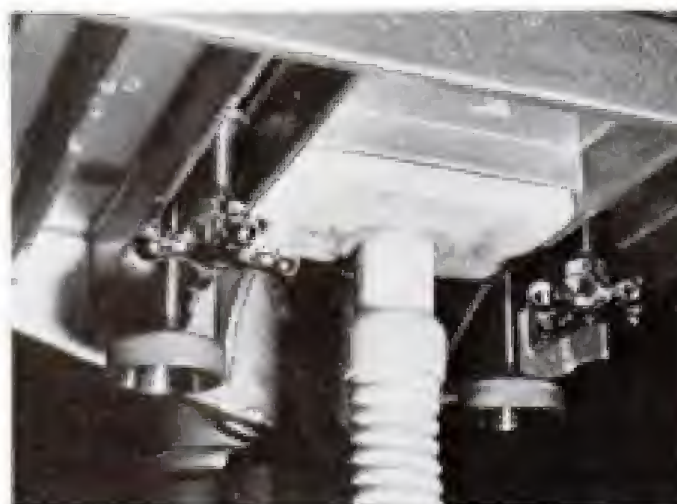
Opfer's belt system

Opfer's method of replacing a power tool's conventional V-belt with the smaller, more efficient Polyflex belt results in a much smoother-running machine. The replacement belt (which is available wherever Gates belts are sold) means that you must custom-turn new pulleys (and throw away the old ones), according to Opfer, because you can't buy what you need.

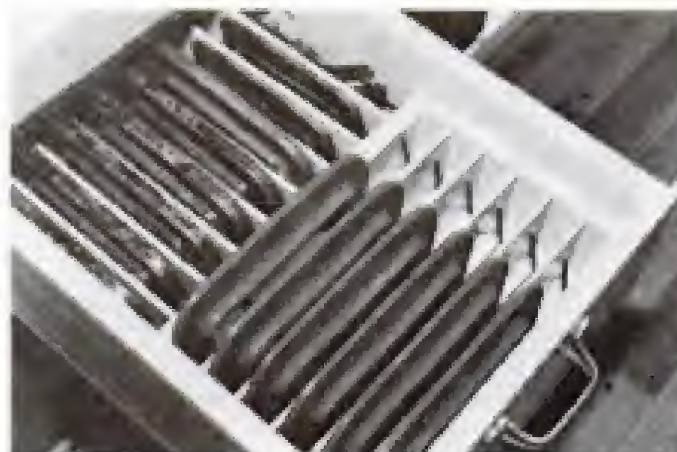
I did some cutting on the table saw shown in the photos on page 108, which happens to be the same make and model as the one I own. I found it to be the smoothest- and truest-cutting table saw that I have ever used. Because of the importance of this improvement, and the belief that many PM readers would like to share the know-how for making it, we are in the early stages of doing a how-to report on the customization. If things go as planned, you will see it in print in the next few months.—H.W.



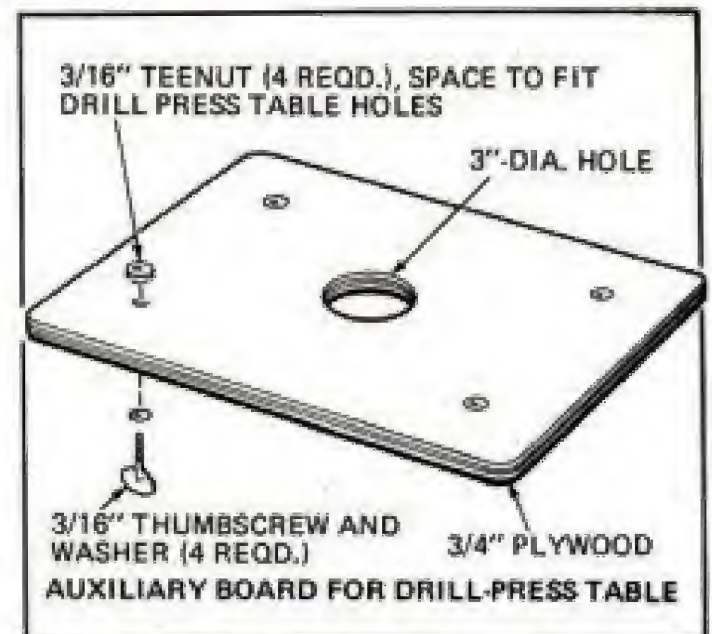
A great shop jig—a sanding board for your drill-press table. This one makes it a snap to use the drum sander. Plywood is installed on table with four thumbscrews.



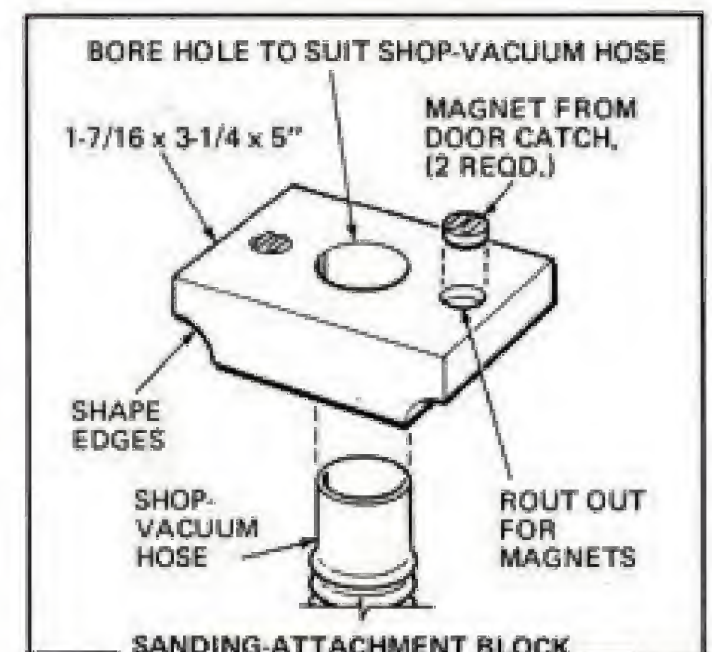
Wooden block is shaped to fit between the ribs on underside of drill-press table. It is held there with a pair of magnets.



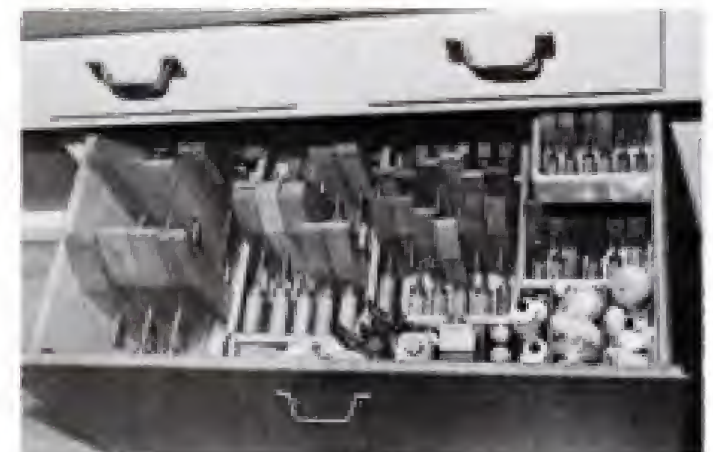
All drawers in the Opfer shop are completely organized. Top drawer in the master bench keeps all of his C-clamps corraled.



Size the auxiliary table to suit the work you do most often. Clamp board to table to locate the holes for the thumbscrews.



Cut the block from 5/4-in. pine and shape to suit. Hole for vacuum hose should be a snug fit, and the two door-catch magnets should be recessed in mortised holes.



Deep drawer in same bench contains assortment of hand screws, glue, web clamps. Because of weight, drawer is on slides.

A craftsman's mini-turnings



His lathe runs so true owner can make miniature turnings like these. Screw at far right is a commercial 1½-in. screw.



The surprise is this full-size needle—inside the wooden screw. Yep! Opfer turned the wooden needle on the lathe, too.

CONTEMPORARY TOOLBOX

(Continued from page 117)



Retractable block is raised with apex of the V flush with top surface when you work round piece, such as dowel or pipe.

2. Next, cut the rabbet and dado grooves as shown in the drawing. Temporarily assemble all parts without glue to check their fit. Mark any pieces that need refitting. Disassemble and reshape as needed.

3. To assemble, glue the false bottom and top into the sidepieces and the backpiece; omit the front piece at this time.

4. Cut the $\frac{1}{8} \times \frac{3}{4}$ -in. center drawer guides from hardwood stock. Mark the center of each drawer opening and, using a square and pencil, mark the center-guide strip locations. Glue them in place.

5. Assemble the drawers with nails and glue. Test drawers for fit before the glue dries; leave the drawers in place overnight.

6. Using clamps to hold all pieces together temporarily, assemble remaining pieces with glue, screws.

7. Install the four drawers. Cut a $\frac{1}{8} \times \frac{3}{4}$ -in. notch in the bottom back edge of each drawer to straddle its center guide strip.

8. Finish with satin-finish varnish. **FM**

MATERIALS LIST—TOOLBOX

Key	No.	Size and description (use)
A	1	$\frac{3}{4} \times 5\frac{1}{2} \times 25\frac{1}{2}$ " Baltic Birch plywood (top)
B	2	$\frac{3}{4} \times 11 \times 12$ " Baltic Birch plywood (sides)
C	1	$\frac{3}{4} \times 7\frac{1}{2} \times 24\frac{1}{2}$ " Baltic Birch plywood (back)
D	2	$\frac{3}{4} \times \frac{3}{4} \times 24\frac{1}{2}$ " pine (saw-retaining guides)
E	1	$\frac{1}{4} \times 10 \times 25$ " hardboard (shelf)
F	1	$\frac{1}{4} \times 10 \times 25$ " hardboard (bottom)
G	1	$\frac{3}{4} \times 4 \times 4$ " Baltic Birch plywood (bench stop)
H	1	$\frac{3}{4} \times 7\frac{1}{2} \times 26$ " Baltic Birch plywood (front)
I	4	$\frac{1}{8} \times \frac{3}{4} \times 8\frac{1}{2}$ " hardwood (drawer guides)
J	18	No. 8 $\times 2$ " fn screws
K	18	$\frac{3}{4}$ " wood plugs
L	8	$\frac{1}{2} \times 2\frac{3}{4} \times 10$ " plywood (drawer sides)
M	4	$\frac{1}{2} \times 2\frac{3}{4} \times 5\frac{1}{2}$ " plywood (drawer backs)
N	4	$\frac{1}{2} \times 2\frac{3}{4} \times 5\frac{1}{2}$ " hardwood (drawer fronts)
O	4	Merit flush-ring pulls, Model No. 11510-3
P	4	$\frac{1}{4} \times 5\frac{1}{2} \times 9\frac{1}{2}$ " plywood (drawer bottoms)
Q	1	2' \times length to suit, nylon webbing
R	2	$\frac{3}{4}$ -dia. $\times 2$ " dowels
S	2	$\frac{1}{4} \times 2$ " carriage bolts with wingnuts and washers

Misc.: White glue, 4d finishing nails, 4 bullet catches, 4 recessed finger pulls, urethane finish.

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'81 OUTBOARDS

(Continued from page 101)

of 13 percent in fuel were reported during one test. Johnson will offer a Sailmaster 9.9 and Evinrude a Sail model of the same power with up to 140 pounds reverse thrust for maneuvering. A kit can boost the reverse thrust of tuned-exhaust 15s.

Horsepowers for Johnson and Evinrude will range from 2 for the one-cylinder, 24-pound mini, up



For cruisers, a big bolt-on like Evinrude's 235 gives planing speeds even with throttle set at the economy-cruise position.



Largest production outboard is still the Mercury 300-hp, with power to push large houseboats and offshore fishing craft.

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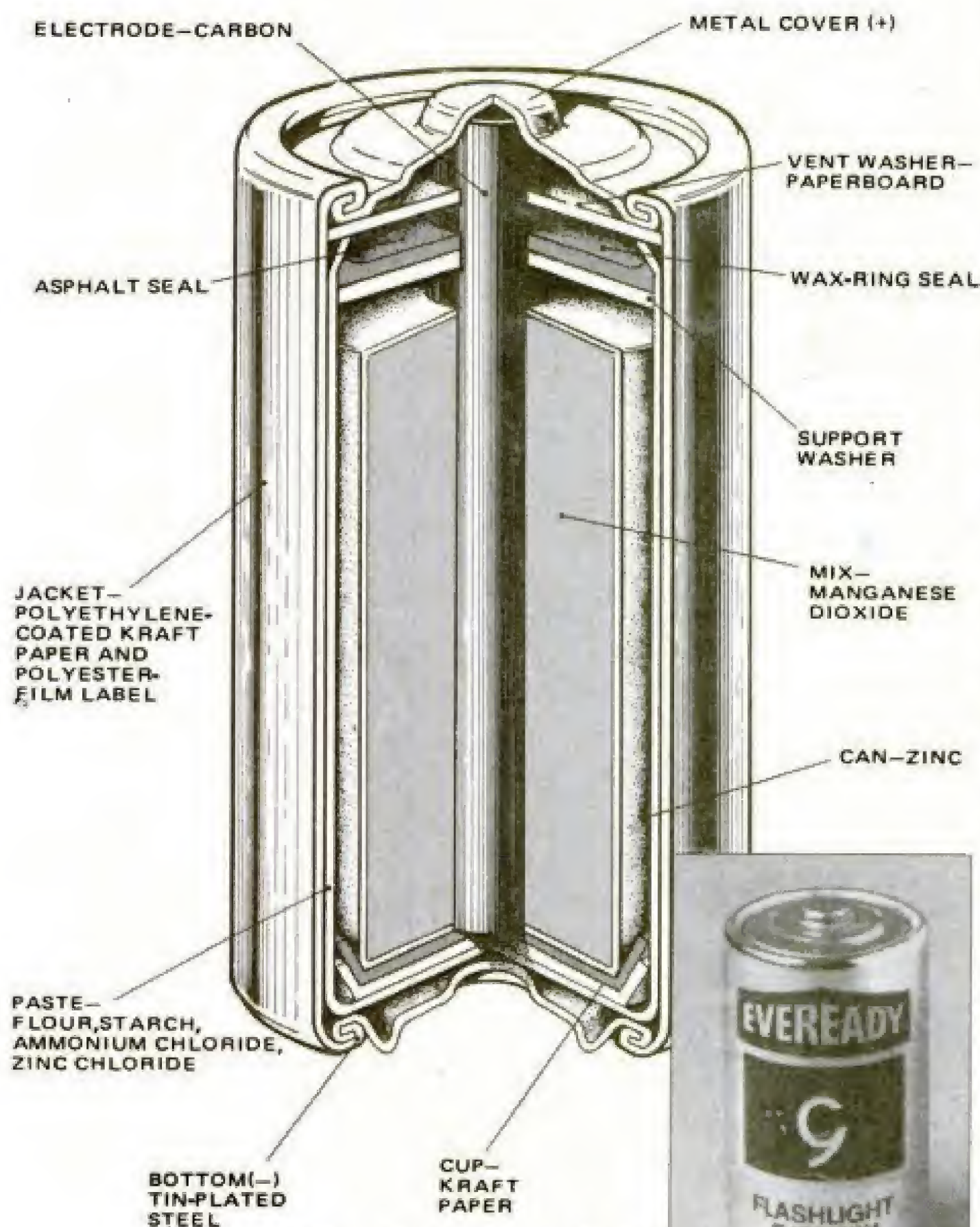
through 4, 4.5, 7.5, 9.9, 15, 25, the new 35, 50, 55 (with manual start and tiller steering for workboats), 60, 70, 75, the new 90, 115, 140, and V6s of 150, 175, 200 and 235.

Chrysler newcomers are an Economate 3.5-hp and an Economate 50. Both claim light weight and superior fuel economy. Also in the line will be horsepowers of 4, 6, 7.5, 9.9, plus 9.9 and 15 Sailors, 20, 30, 45, 55, 75, 85, 100, 115 and 140. **PM**

Everything you need to know about little batteries

More and more of today's electronics depend on batteries for power. There are literally hundreds of battery types. How can you choose the right one? Just check our handy guide.

by Jeff Sandler



Carbon-zinc battery is the workhorse of the industry and is also the lowest priced.

Think back. Five or 10 years ago you had no electronic games, LCD watches, cassette recorders, television games or portable fluorescent lights. Now you do! And they all gobble batteries, which, like any energy source nowadays, are no longer cheap.

Luckily, 85 percent of batteries sold are 9-volt radio flat cells or AA, C and D round cells. It makes selection much easier, considering that there are more than 400 different batteries available.

Carbon-zinc batteries

The common carbon-zinc dry cell you're familiar with has been sold for more than 90 years. Today, it is still the most widely used battery. Because of its low cost, in low-drain applications such as in radios, it can outperform the next best battery (the alkaline) by two to one in cost-per-hour use.

But—because of its internal chemistry—heavy, continuous current drain drives its efficiency way down. The faster you have to draw out power, the less you get. Other batteries have this problem, too, but not to the degree of the carbon-zinc.

Therefore, if Junior has a super-strong, walking, talking, motorized space robot that he wants to show off to his friends, avoid using carbon-zincs. The huge current appetite of this type of device will exhaust the batteries rapidly.

Yet, despite this, there are some heavy-drain situations where it is smart to use a carbon-zinc. A flashlight or toy that draws heavy current may be used so infrequently that even a carbon-zinc won't run down. There is little point in buying a more expensive battery when its capacity will never be used.

Current drain isn't the only consideration. For example, carbon-zincs are essentially useless below 20° F. So forget using them for auto-winding your camera on a ski trip. However, their performance improves steadily with increased temperatures, reaching a peak at about 100° F.

Important: Just because carbon-



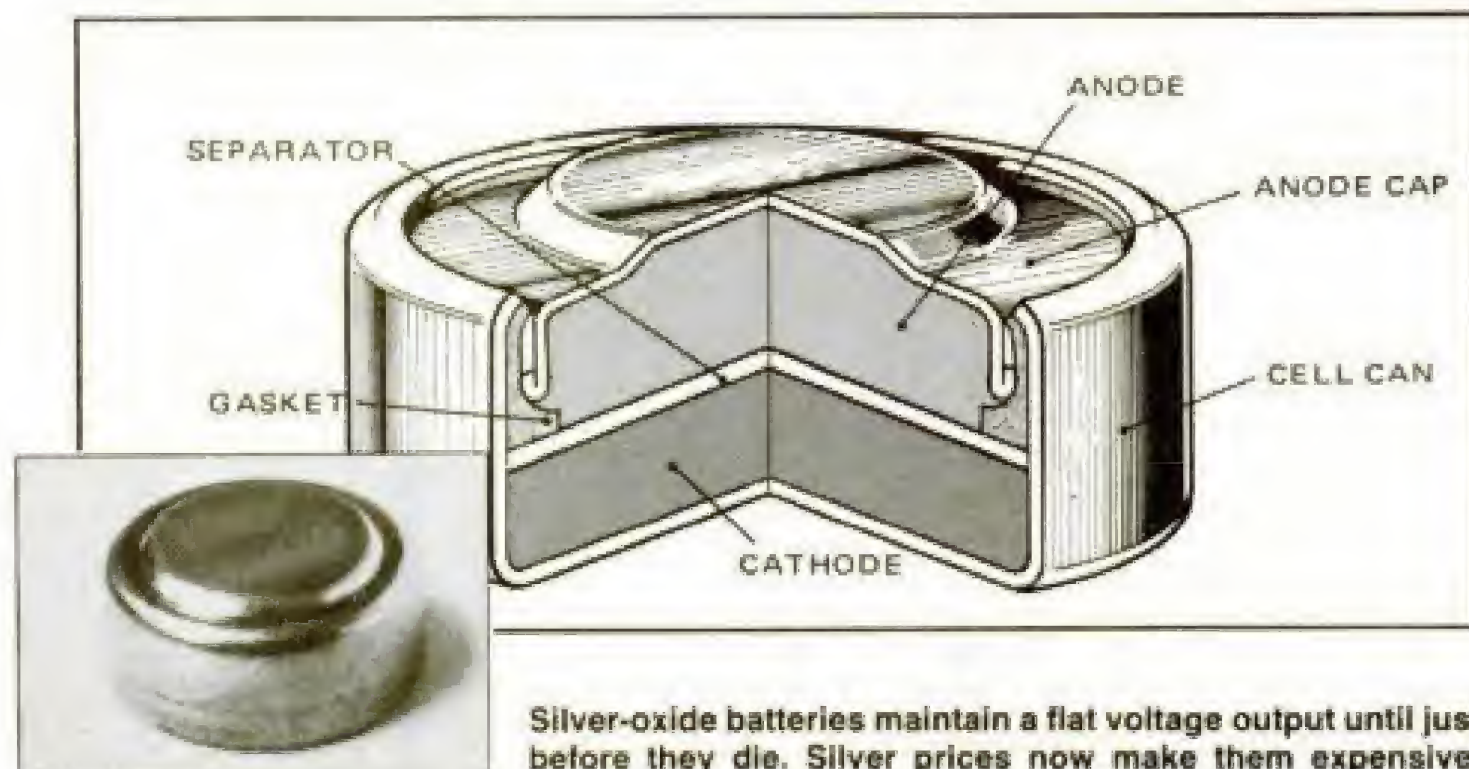
CARBON-ZINC



HEAVY-DUTY



SILVER-OXIDE



Silver-oxide batteries maintain a flat voltage output until just before they die. Silver prices now make them expensive.

zinc batteries perform well in the heat, don't expect that they will store better that way.

High temperatures will greatly accelerate self-discharge, causing rapid battery deterioration and destroying their otherwise good shelf life.

Heavy-duty cells

You've probably seen batteries marked "heavy duty." But, are they really?

Generally, they are a form of carbon-zinc that uses a different construction and an electrolyte (zinc chloride).

You get 50 percent more capacity and somewhat better cold-temperature performance, along with—you guessed it—a 50 percent higher price tag.

Alkalines

You get what you pay for. Alkalines outperform all except the expensive, special types. They are good at high currents, work well in the cold, and have an excellent shelf life. In sum, they perform well in precisely the areas in which the carbon-zinc fails.

When the carbon-zincs are suffering under heavy currents, losing 90 percent of their capacity, it's the alkalines' turn to shine. Now they have the advantage, by a whopping 5 to 1 margin. What they say in the ads about alkalines is true. In toys, photoflash and other heavy-current devices, don't even consider another battery.

Of course, there has to be a break-even point. Generally, it falls at medium currents. However, since rest

periods help carbon-zincs, the break-even point rises to somewhat higher currents with intermittent use. Also, the edge goes to the alkalines if you need very long (over five years) shelf life.

Alkalines and carbon-zincs share what is called a sloping voltage discharge. This means that their voltage falls gradually as they are discharged. The lower the cutoff your device can tolerate, the more energy you will get from the battery.

An ace in the hole

The major battery cards are on the table, and you've picked the best hand. So that's it; the dealing is done. You're not going to save any more. Not right! How would you like to take whatever costs you've gotten down to and cut them in half, or even by two-thirds?

Just look for sales! Don't laugh. This one tip may save you more than anything we've said so far. The battery-marketing structure is such that there are often sizable discounts (and cash rebates) of 50 percent or more off list price.

Batteries on the moon

Silver-oxide, the type of battery that powered the lunar buggy, would make a fantastic battery for your flashlight. It would power it three times as long as an alkaline, and your light wouldn't dim at all until the battery was totally exhausted. Just one tiny "catch"—it would cost \$9.10 per hour!

ALKALINE



MERCURY



NICKEL-CADMIUM WITH CHARGER



Here on earth, you'll find silver-oxide batteries in watches, calculators, hearing aids and cameras as "button" cells. They are ideally suited to these applications because they have one of the highest energy contents for their size of any consumer battery. Unlike carbon-zincs and alkalines, the voltage doesn't fall gradually during discharge, and this is important for the accuracy of watch circuits. Yet, despite their tiny size, they cost about \$3 each.

Mercury cells

Like the silver-oxide, mercury batteries find wide use in button-cell applications, but they cost half as much. However, *you can't indiscriminately replace a silver cell with a mercury*. This is because mercury has a lower operating voltage (1.35 or 1.4 volts). Many circuits, especially timekeeping ones like watches, can't take the one-fifth of a volt difference between the silver-oxide and mercury.

Luckily, hearing aids, which use up a lot of batteries, will not be damaged by a change from silver to mercury. Often, the only ill effect, if any, is slightly lower volume. In the future, we can hope to see more devices designed around the cheaper mercury system.

Recently, alkaline button cells have appeared on the market as inexpensive replacements for the silver-oxide and mercury, which have a flat voltage discharge. The alkaline doesn't, and this can cause a

problem in some devices, particularly watches.

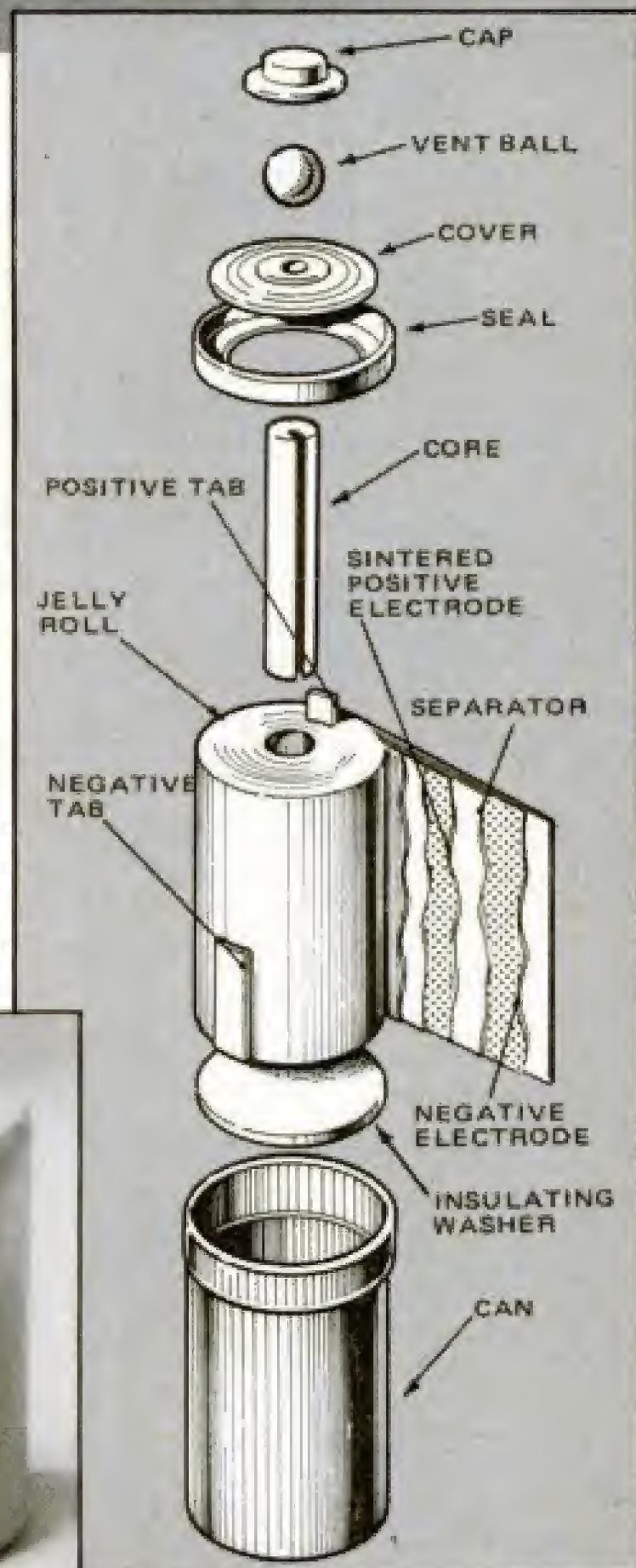
Nickel-cadmium

If you find that your battery budget is breaking your back, then you need rechargeable nickel-cadmium (nicad) batteries. Once you get past the initial high cost, you have virtually free batteries for life, because they can be recharged over 1000 times. Often, the cost per discharge cycle is under a penny.

Usually, they come in the AA, C, D and 9-volt radio sizes. Unlike the button cells, you don't have to worry about the fact that the nicad has a 1.25 voltage rating. The devices that are designed to run on these batteries take into account that the voltage of carbon-zincs and alkalines falls in use. So the nicad's lower voltage is okay.

These batteries can crank out cur-

A nickel-cadmium battery can be recharged up to a thousand times. Because of this, price per use is low. Voltage is somewhat lower than that of a carbon-zinc battery, but a nicad can deliver very powerful current output.



PM'S COMPARISON OF BATTERY LIFE

Type	Voltage	Composition	Weight (in ounces)	*Low drain	Hours of life	*Medium drain	Hours of life	*High drain	Hours of life	Approx. price
AAA	1.5	Carbon zinc	0.3	2	300	10	43	50	2.3	\$.35
AA	1.5	Carbon zinc	0.52	5	240	30	25	100	2.5	.35
C	1.5	Carbon zinc	1.5	10	220	50	20	250	1.5	.45
D	1.5	Carbon zinc	3.0	20	260	100	45	300	4.3	.45
9V	9.0	Carbon zinc	1.5	5	80	10	38	25	1.0	.99
AA	1.5	Zinc chloride	0.6	5	275	30	38	100	6.0	.50
C	1.5	Zinc chloride	1.6	10	330	50	56	250	7.0	.65
D	1.5	Zinc chloride	3.3	20	375	100	65	300	13.0	.65
9V	9.0	Zinc chloride	1.5	5	94	10	45	25	15.0	1.59
AAA	1.5	Alkaline	0.4	2	375	10	73	50	10.0	.90
AA	1.5	Alkaline	0.75	5	340	30	54	100	13.0	1.90
C	1.5	Alkaline	2.2	10	470	50	90	250	13.0	1.13
D	1.5	Alkaline	4.5	20	470	100	91	300	29.0	1.13
9V	9.0	Alkaline	1.6	10	52	30	17	60	8.0	2.25
A76	1.5	Alkaline	0.09	0.1	950	1	90	10	8.0	.99
AA	1.4	Mercury	1.05	5	480	30	80	100	23.0	1.90
675	1.4	Mercury	0.09	0.1	2200	1	215	5	42.0	3.25
AA	1.25	Nickel Cadmium	1.95	5	100	30	17	100	5.0	3.80
C-D	1.25	Nickel Cadmium	2.2	20	60	100	12	300	4.0	4.40
509	6.0	Carbon zinc	21.5	20	500	150	60	500	10.0	2.50
76	1.5	Silver	0.08	0.1	1900	1	190	5	37.0	2.40
544	6.0	Silver	0.5	0.1	1900	1	190	5	37.0	13.90
303	1.5	Silver	0.09	0.1	1650	1	165	5	32.0	4.15
357	1.5	Silver	0.08	0.1	1650	1	190	5	37.0	4.15

* Measured in milliamperes.

Note: 85 percent of carbon zinc and zinc chloride batteries, 95 percent of silver and mercury, 50 percent of nickel cadmium batteries get one year shelf life.

HOW DIFFERENT TYPES OF BATTERIES WORK

	Performance at:			Performance at:		Shelf life at:		
	Low current drain	Medium current drain	High current drain	Low room temp.	High room temp.	Low room temp.	Medium room temp.	High room temp.
Carbon-zinc	E	G	P	P	G	G-E	G	P
Zinc chloride	E	G-E	F-P	F	G	G-E	G	P
Alkaline	E	E	G	G	G	E	E	G-E
Nickel-cadmium	E	E	E	G	G	E	E	G-E
Mercury	E	E	F-E*	F	E	E	E	G
Silver oxide	E	E	F-E*	F	E	E	E	E
Lithium	E	G	P	E	E	E	E	E
Lead-acid	E	E	E	F	G	F	F	F-P

* Depending on type.

Legend: E=excellent; G=good; F=fair; P=poor.

rent levels that would put the powerful alkaline to shame. That's why you see them in extra-heavy-current applications, like hedge trimmers and soldering irons.

Tomorrow's batteries

Recently, Radio Shack and Sears came out with lead-acid lantern batteries. These are rechargeable, have a "gelled" electrolyte, and don't need added water. If you use over two lantern batteries a year, these batteries would be a good investment.

You may see lithium cells taking over a good portion of the watch (button) and calculator market in the next five or 10 years. It's because they have an incredible shelf life that is measured in terms of decades!

In a photo on page 153 is the same type of 6-volt, carbon-zinc battery that was an integral part of the Polaroid film packs. It is now available to the consumer as a separate battery for special applications where

This page, a gold mine of information, is easy to use. The above chart, "How Different Types of Batteries Work," outlines the relative strengths of each battery-chemical system. Pick the best one for you.

Once you decide on the battery chemistry, get specific data from the top chart, "PM's Comparison of Battery Life." You can see how long a particular battery will last at different currents, how much it will cost, its weight, and so on.

To calculate how long something will be powered by a battery, see the chart at right, "Current Drain in Various Devices." Find the amount of current your device requires. Now look in the top chart for the closest estimated drain value to your more exact figure. Multiply the chart's estimate by the "hours of life" figure next to it. Divide this figure by your original, exact drain figure. Result is actual hours of life.

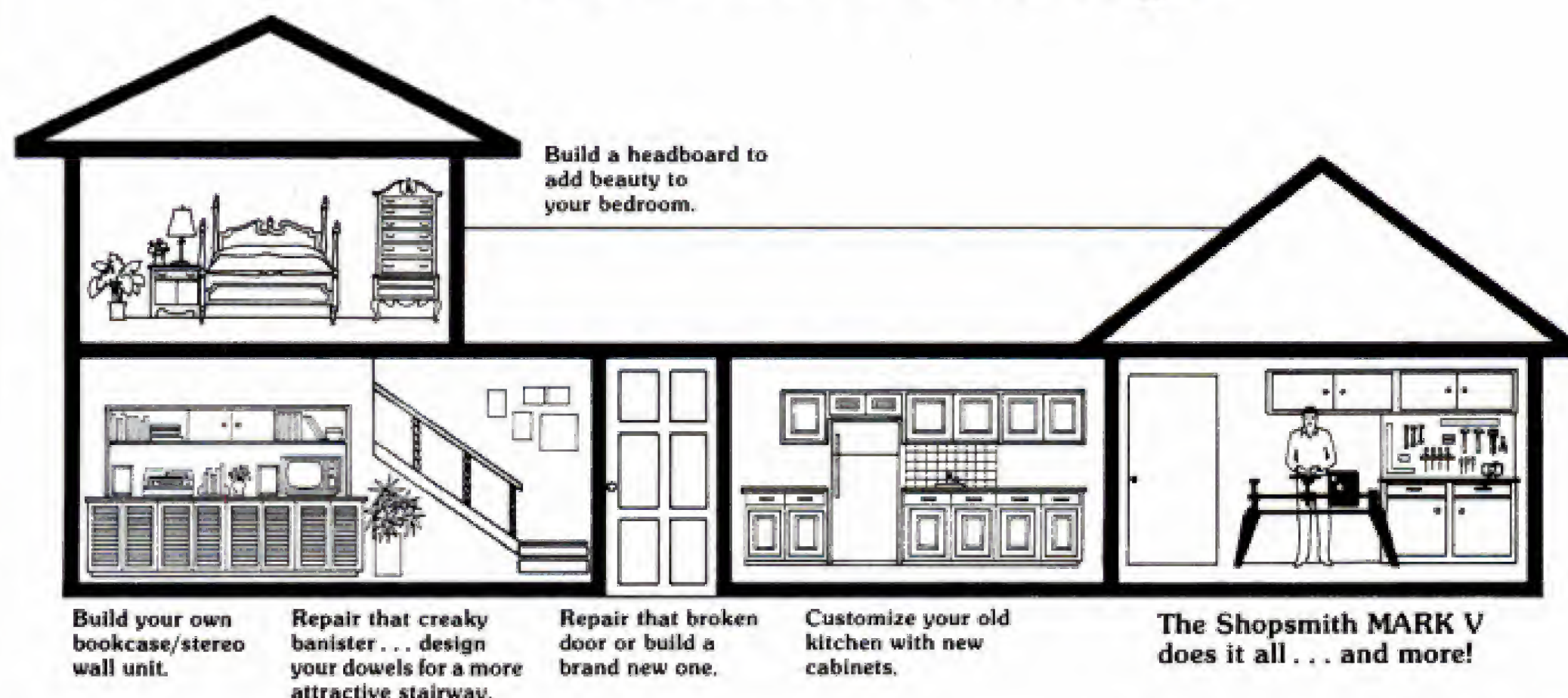
space is, at a premium or there are momentary, large surges of current. Other than the fact that it's able to put out a 25-amp. pulse, it's similar in basic characteristics to the ordinary carbon-zinc battery of comparable size.

PM

CURRENT DRAIN IN VARIOUS DEVICES (Measured in milliamperes)

Device	Current Drain (volume)
Radios (with 9-v. battery)	8-12 (low) 10-15 (medium) 15-45 (high)
(with round batteries)	10-20 (low) 20-30 (medium) 30-100 (high) 100+ (blasting)
Cassette Recorders	70-130 (low) 90-150 (medium) 100-200 (high)
Calculators LED (9-v. battery) LED (AA batteries) Fluorescent (green) LCD	20-30 40-100 20-50 under 1
Fluorescent Lamp (one 6-w. bulb)	500-1000
Flashlights	500-1000
Toys Motorized type Electronic games Video games	400-2000 20-200 20-200
Cameras Photo flash Autowind	1000-2000 200-300
Watches LCDs LEDs	10-25, back-lighted 10-40, lighted
TVs (portable)	500-1500, depending on unit

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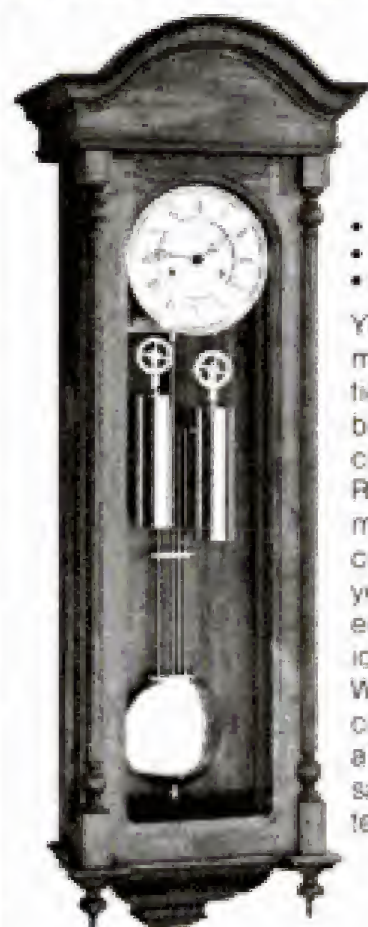
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NEW HEADPHONES

(Continued from page 97)

man voice or a full orchestra.
■ Koss Pro-4AAA (\$75, sealed, 15½ oz.)

This is one of the most successful rock headphones. Low notes are sharply curtailed, there is a mid-bass rise and there is a strong "hot-off-the-amp" treble. At high volume, the sizzling sound can rattle you.

■ Sennheiser HD-420 (\$85, open, 4 oz.)

This is an accurate piece of hardware with a sophisticated sound. It is characterized by an airy presence that has come to be associated with this, the company that effectively introduced open-air designs. The sound possesses sheen and polish, rather than weight and impact. At 4 ounces, it is comfortable and easily forgotten once on the head.

■ Technics EAH-820 (\$60, open, 12 oz.)

Light, airy sound with refinement, rather than weight, characterizes the EAH-820. When we missed the deepest bass, we found that boosting the lower end caused a sort of overkill in mid-bass. Nonetheless, jazz and folk music work quite well. Use this set where clarity outweighs bass.

Top-of-the-line models

Two dynamic, one hybrid dynamic-electrostatic and four electrostatic headphones (feature below) make up this array of expensive and often exotic equalization. We weren't surprised when these racehorses did practically anything.

■ AKG K-340 (\$189, open, 13½ oz.)

This is the "headphone of the year" in our judgment—the most musical headset we've ever heard. *Nothing* sounded bad except bad music. Its sound is closely related to the less expensive K-240, but surpasses it in depth, clarity and acoustical spaciousness. The high-frequency headroom is simply unique and appears to know no stress. The bass reproduces even a soft 32-foot organ pipe or the contrabasses of an orchestra at full throttle. The hallmark of a headphone set like this is accuracy and clarity, not sonic fireworks.

■ Beyer ET-1000 (\$279, sealed, 13 oz.)

A sealed electrostatic headphone, the ET-1000 has good comfort. Tonal adjustment presents delicate problems, but the time spent to achieve the best sound is well worth it.

■ Burwen PMB-8 (\$115, sealed, 12 oz.)

This dynamic headphone should

THE FOUR TYPES OF HEADPHONES

As our illustration shows, a *sealed* headphone has a solid shell and isolates the ear from nearly all outside noise. An *open* headphone provides venting at the rear so that you can hear nearby sounds, such as conversations.

An open headphone offers airy sound, the ability to hear room noises and light wearing pressure. Disadvantages might be that the bass often needs boosting and some models can be overloaded at high volume.

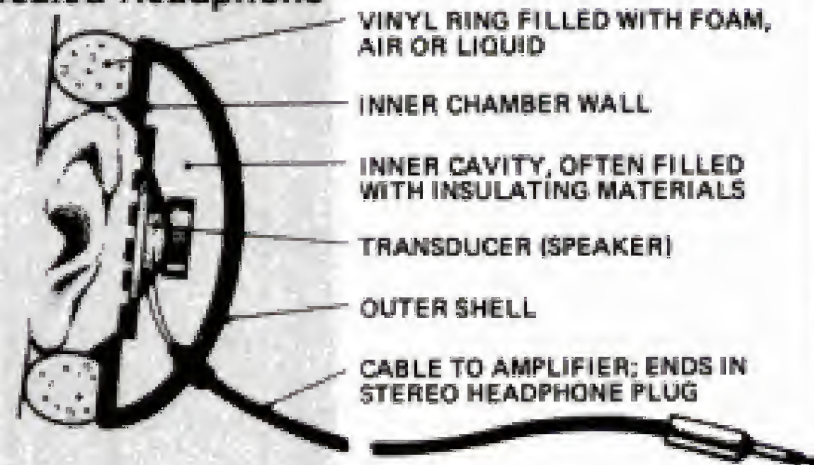
A sealed headphone offers deep, strong bass, along with high sound levels and complete isolation from outside distractions. However, watch out for boominess, undesired bass and mid-range resonances.

Electrostatic headphones are powerhouses that require an external voltage supply. These offer accurate and sharp treble, excellent transient response and all-around good definition (phasing) of the music. Some drawbacks are inadequate bass at high volume, a lack of mobility (due to connection to power module) and the fact that most electrostatic headphones use one of the stereo speaker connection points at the amplifier. That might rule out attaching a second set of speakers.

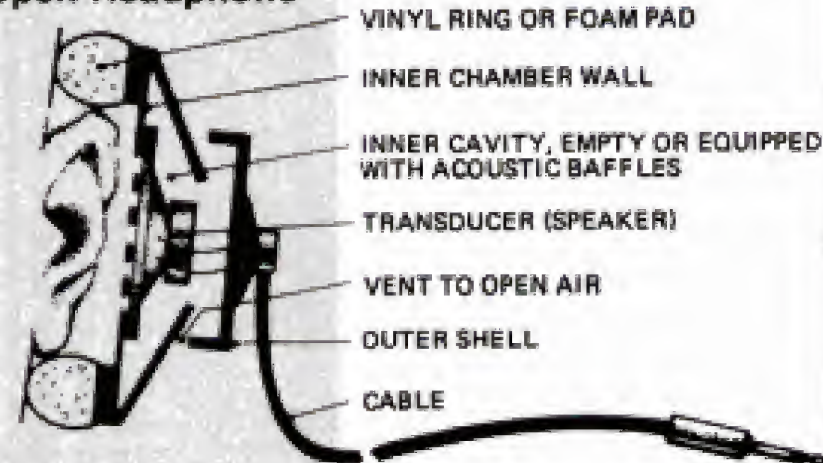
Dynamic headphones have a

vibrating diaphragm attached to a coil of wires. This coil vibrates within a magnetic field, which causes the diaphragm to act as a speaker. Advantages include powerful bass; a disadvantage is weight.

Sealed Headphone



Open Headphone



be used with an equalizer to realize its best sound. A small rise in the mid-range equalizes out the most critical anomalies, providing excellent definition in this critical range. Without tonal fiddling, it is a forward, rather assertive headset.

■ **Infinity ES-1 (\$275, open, 9 oz.)**

The least efficient of the headsets tested, the ES-1 also has the best transients—logical if you think of the amount of power used for normal listening levels. This set takes more volume than most.

■ **Koss ESP-10 (\$350, open, 14 oz.)**

This set is characterized by an accurate, kind definition to any music. Everything is there, including the bass. It's the best Koss we've heard in years. Though slightly uncom-



AKG K-340 for \$189 is an electrostatic headphone that our reviewer liked best.

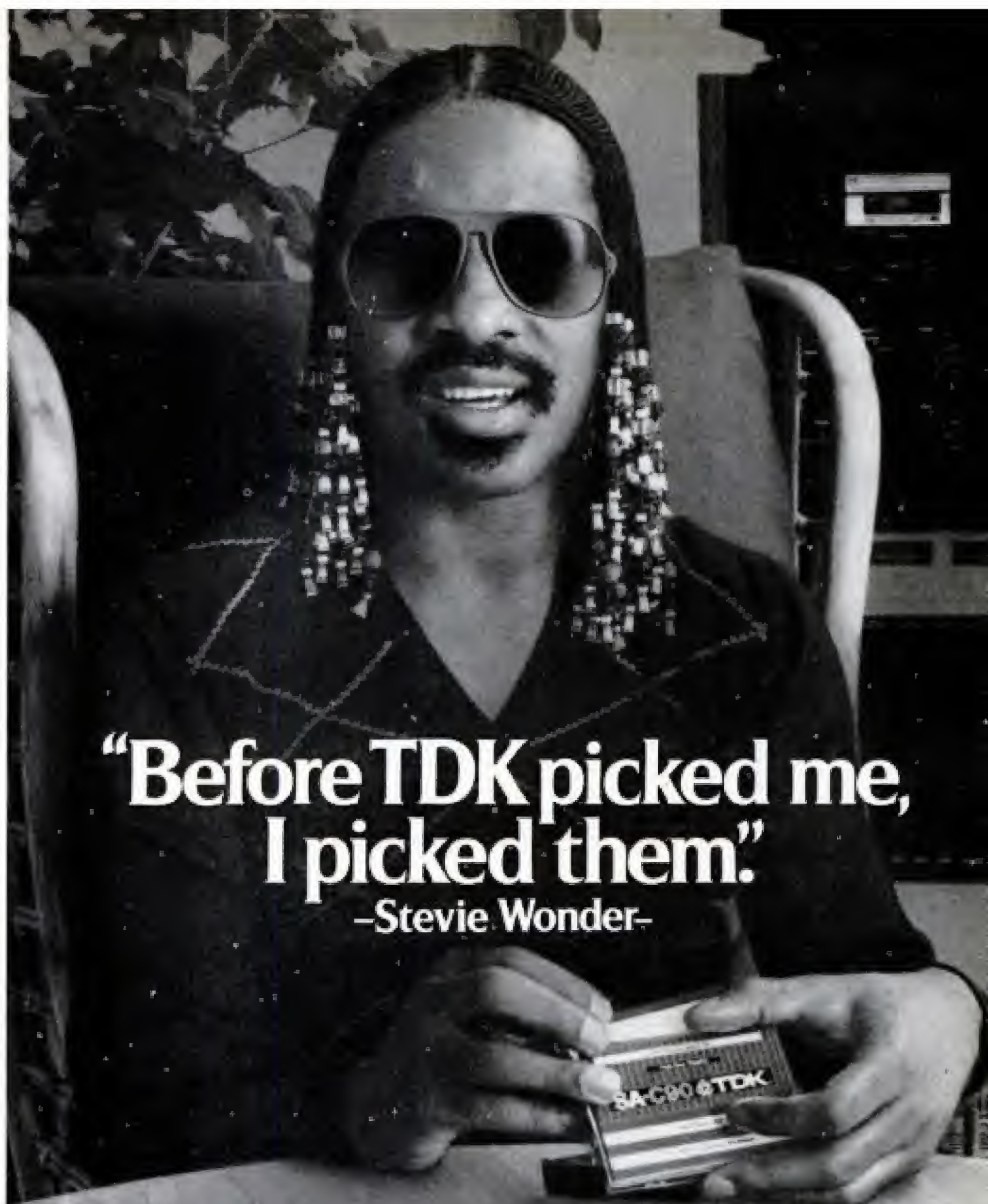
fortable for long listening, it responds well to creative equalization and appears to have no "prejudice" for any one kind of music.

■ **Sennheiser HD-430 (\$119, open, 7 oz.)**

Though most dynamics have stronger bass to begin with, the HD-430 responds quite well to a tasteful boost to put out a realistic and credible bass. This set, with the AKG 240 and 340, is one of the most comfortable we tested.

■ **Superex PEP-81 (\$150, sealed, 8½ oz.)**

This is the most conveniently equipped of the electrostatics. It features a 15-foot cord, light weight (8½ ounces) and volume knobs on the power module. A simple and complete 11-page manual is helpful in understanding this model and electrostatics in general. This is the only electrostatic among those we include here that can also be used without being powered. **PM**



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AVOID HIGHWAY ACCIDENTS

(Continued from page 89)

before and after the 55-mph limit.

The important thing to remember is that the 55-mph speed limit (or any other local speed limit) can never be safe under all conditions. You have to know when to slow down.

As you drive, look at your rear-view mirrors, and scan the road up ahead. Is the highway clear of heavy traffic? Is the road surface smooth? Are you well rested and alert? If so, you can drive safely at the speed limit. Conversely, if traffic is heavy or road conditions are poor, you must slow down.

Always drive at a pace that is comfortable to you. If you slow down on a highway because of poor conditions, and find that all other drivers are passing you because you are tying up the road, you might be better off on a slower secondary route.

Failure to yield

In the 1978 NSC survey, accidents involving motorists' right of way were the largest single category of accidents (20.4 percent) when taken together as a group. Right-of-way accidents are broken down into three subcategories, the first being failure to yield. The second and third are passing stop signs and disregarding traffic signals. Failure to yield accounted for a huge 15.7 percent of all accidents in 1978, up 4.9 percent over 1977 levels.

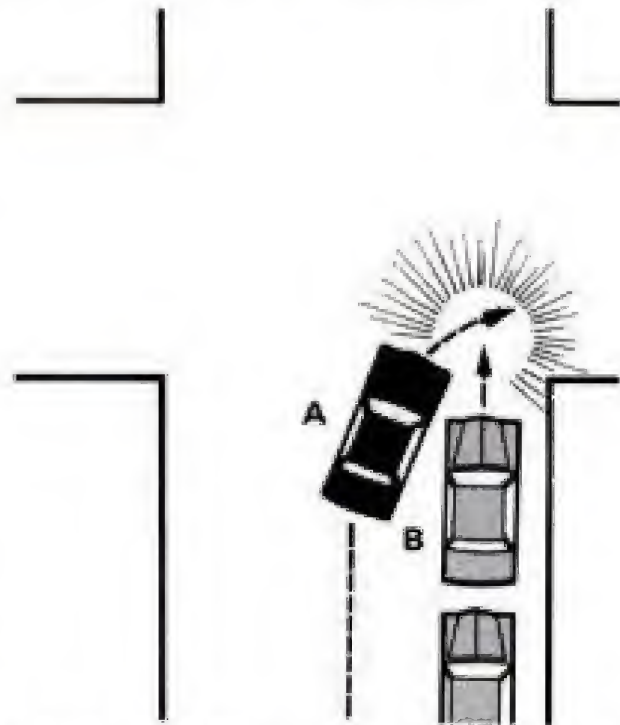
The main problem here involves drivers who haphazardly enter highways without looking for oncoming traffic. Another problem occurs when a driver is trying to enter a main road where visibility to his side is blocked by an obstruction, such as a wall or tree. He creeps forward, sees a car coming and stops again. But the car behind him has already started moving and fails to see him stop again. A rear-end collision then results because the first car has *obeyed* the right of way.

Avoiding collisions when entering and leaving main routes calls for simple common sense. When you enter a highway, notice the flow of oncoming traffic and try to estimate its speed. When there is a wide gap in the traffic, pull out and get up to speed *quickly*.

Should you have to creep up the entrance ramp to get a good look at traffic, do so slowly—especially if there is another car behind you—and keep your brake lights on (with a light, intermittent tap on the brake pedal). This will serve as a warning to the car(s) behind you.

Once you are on a highway or fast-

moving main route, you should be on the lookout for "turbulence," traffic engineers' parlance for cars and pedestrians that may want to enter the right of way from driveways or side roads. The more turbulence there is, the more you must slow down in anticipation of someone violating your right of way. Be especially wary of cars that shoot out of driveways, cars that suddenly leave parking spaces (especially at corners), and cars that cut you off at entrances to main roads or highways. To avoid turbulence, stay in



Car A is about to make a right turn. Car B, parked at the curb, moves off without seeing A bearing down. Remember, even stationary cars pose a potential threat.

the left-hand or middle lane of two- or three-lane (each direction) highways when passing busy entrance or exit ramps. It's safer there.

Disregarding traffic signals

Passing stop signs and disregarding traffic signals accounted for 4.7 percent of all accidents and 4.1 percent of all fatalities on the nation's highways in 1978.

When you are driving on a main road, always observe any vehicles about to enter the road from side streets. Even if you have the light, a car on a cross street may disobey a signal and suddenly shoot out in front of you. In situations like this, you must slow down and find yourself an out—a path of safe travel—because you won't usually have enough room to come to a complete stop if you are cut off suddenly.

In this situation, where a collision is imminent, the best thing to do is swerve and brake hard. Steer toward a road shoulder, a driveway or any daylight you have.

Driving on the wrong side

It should be obvious that driving on the wrong side, officially called

(Please turn to page 162)

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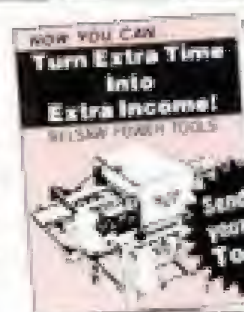
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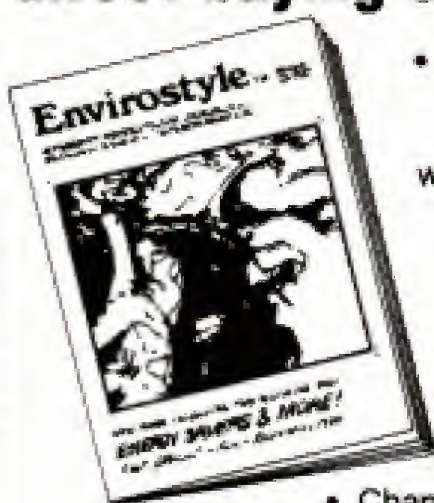
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AVOID HIGHWAY ACCIDENTS

(Continued from page 160)

driving left of center, is one of the most deadly causes of accidents. It accounted for 4.8 percent of all accidents in 1978 and 15.1 percent of all traffic-related deaths. And these figures are up significantly over 1977 statistics (3.6 percent and 10.5 percent, respectively).

Two-lane highways, the deadliest roads of all, are usually the site for these types of accidents, although such accidents do sometimes occur even on well-marked interstates.

If you see a car coming at you in your lane, what should you do? The answer is to be a defensive driver and always look for an out by scanning the shoulder to your right to find tentative escape routes as you drive along. If a car approaches you in your lane, you may be able to veer off the road to the right.

Having to drive off the road into bushes, fields or even small ditches is better than a head-on collision.

The person driving on the wrong side of the road may be drunk, drugged, reckless or simply making a severe error in judgment. But from where you're sitting, it doesn't much matter. What you have to do is get out of his way. Dive for cover to the right and never get into the left lane to avoid him. You might hit a car behind him or he might pull back into his lane at the last second.

Improper overtaking

Improper overtaking is the reverse problem of driving on the wrong side. Should another car be passing you in the same direction you are traveling, and the driver faces an imminent head-on collision, slow down as much as possible, which will enable him to get back into the right lane sooner. In an emergency, pull off the road if it looks as if the driver passing you is about to have a head-on collision just a few feet to your left. This will give him a final out.

When you are passing other cars, do so with care and only at the proper time. The dotted line should be showing in your lane, but this is not enough. Sometimes, passing lines are painted in the fall or winter, when there are fewer leaves on the trees and visibility is good. In summer, leaves can often block your view of the road ahead, making passing no longer safe. When you can see clearly, signal your intentions and gently pull over into the left lane. Now straighten out and accelerate briskly. Signal right, but don't pull over until you see the driver you've passed in your rear-view mirror.

Improper turns

Improper turns caused 3.9 percent of all traffic accidents in 1978. To illustrate some of these situations, we've included diagrams of four classic intersection blunders.

In general, you should signal turns well in advance. Don't dilly-dally when making right-hand turns off a main road. On the other hand, don't make them too fast, either.

Left-hand turns require the utmost care. Tap your brakes to warn other drivers you are slowing down, and when you reach your intersection, pull into the middle of it so you don't block others who may want to turn right (on two-lane roads).

Tailgating

Tailgating was the second largest single cause of accidents in the 1978 study (8.6 percent).

How can you be sure that you are not following too closely?

"Use the two-second rule," counsels Dick Tippie of the NSC. "As you are driving along, note when the car in front of you passes a landmark and then count one-one thousand, two-one thousand. If you reach the landmark before you can finish counting, you are following that car too closely."

Dick assured me that his rule works at all speeds and is much simpler than the old rule of one car length per 10 mph. I tried it myself and found it effective.

Drunks, drugs and psychos

According to all the statistics gathered by government and privately funded studies, drinking was a major factor in over half of the highway fatalities. This statistic has remained constant for years. No matter how intensive the campaigns to get drivers off the bottle, DWI (driving while intoxicated) kills an average of 25,000 people a year.

Since no one has come up with a successful method to stop drivers from drinking, the only alternative we have is to be aggressively defensive. That means having your sensory radar turned up to maximum whenever you get behind the wheel. Try to spot the drunk before he spots you. Scan the road ahead as far as you can. Train your eye to detect a weaving car, or one that's speeding or cutting other cars off.

Do the same with your rear-view mirror. Don't spend too long gazing into it, however, or you're likely to hit something.

What do you do if you spot a drunk? First of all, get out of his way. The experts tell us to treat drunk drivers as if they were mad dogs. That means don't startle him

by leaning on the horn, flashing your brights or trying to shake him out of his stupor by pulling up to him and making gestures. It might startle him into making an erratic maneuver, or make him so belligerent he might try to ram you. Stay well behind him.

If you can, try to alert the nearest police that there's a drunk on the road. If you've got a CB, get on Channel 9, the emergency channel, and start broadcasting. We've seen this work. The police and other motorists will appreciate this and you might save someone's life.

The above-mentioned tactics hold true for the drugged or reckless drivers. Although there is no hard statistical evidence, a reckless driver is often a disturbed individual, hell-bent on murder or suicide.

Due to incomplete methods of accident reporting, no nationwide statistics exist on the effects of drugs on accidents. But there is a strong suspicion, based on the limited studies done in selected areas, that drugs, mostly the depressants and hypnotics, are becoming a major factor. Unlike alcohol, a drugged individual won't show obvious signs that his judgment is severely impaired—until he's behind the wheel.

Cheap insurance

The cheapest insurance you'll ever buy comes as standard equipment on your car—seat belts. Wear them all the time. It's been estimated that if 70 percent of all drivers and passengers wore seat belts, it would save 12,000 lives a year. That's quite a chunk of the annual toll. Even if you're going two miles down the road, use the belts. Most accidents still happen within 25 miles of home.

The following are recommendations we've gathered from various safety agencies.

■ Stay alert. Don't drive when you're tired or don't feel well.

■ Turn down the radio. Don't surround yourself in a cocoon of music. It might drown out a car horn, screeching brakes or other sound that could warn you of trouble.

■ Be careful of drugs. Even over-the-counter cold medications can impair your reflexes or make you drowsy. If you must drive while on medication, remind yourself that you're not as sharp as you think. Give yourself plenty of room for error.

■ Always use your signals. Don't make anyone guess your intentions. Signal all your movements well ahead of time.

Finally, drive as if your life depends on it. The potential for an accident is always with you. **PM**



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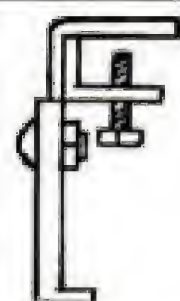
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CRAFTSMAN'S WORKBENCH

(Continued from page 115)

more vises to ensure good holding capability for certain operations.

The PM bench meets all these requirements—and then some. Its good-size top is finished with durable, oak strip flooring laid over a stout 2×6 subtop. Lumber throughout is of framing dimensions, and you will notice that the bench's back wall is as sturdy as a house wall. The bench itself is lagscrewed to the "wall." There is ample storage for hand tools, and we have provided space below for larger items, too.

The pint-size version is less sturdy, of course, but you will be pleasantly surprised at just how rugged it is. The bench project is a good way to introduce your youngster to woodworking, and both of you will derive great satisfaction from building it. What better way for an 8-year-old to learn respect for tools and how to use them? It's sized to suit kids from 8 to 12.

Building Pop's bench

The bench vise hardware—No. 17D03-AW—is available from Woodcraft Supply Corp., 313 Montvale Ave., Woburn, Mass. 01801. Priced at \$70 postpaid, it consists of two parts, the plate and handle assembly. A piece of 2×6 is used to provide a surface for securing the plate.

Hold the plate in position against the underside of the 2×6 and the rear of the front frame member of the bench. Trace the outlines of the three holes; then mark the centers of each circle. Transfer these marks to the front and bore the holes for the handle assembly. These holes are drilled larger than the diameter of the guide rods and vise screw to prevent bindings. The plate is secured with flathead wood screws.

The 2×6 subtop is now nailed in. Note that the last plank receives nailing strips for the trough panel. These are attached before the plank.

The bench front and side rails are rabbeted along their top edges to receive the hardwood top. The rabbet is cut completely through, and the gaps resulting at the ends are filled in with small blocks. The rails are secured with glue and nails.

Tongue-and-groove oak strip flooring is installed in the same manner as it is on floors. Start at the right end with the groove edge butted up against the side rail. Drive three 2-in. finishing nails about 3/4 in. from the lead edge. Drive three flooring nails at an angle of about 45° into the tongue. Pilot holes bored into the tongue (not the base) will prevent splitting.

Hardwood strip flooring is sold in random lengths. Be sure to stagger joints so there is at least a 6-in. offset between them.

Finishing nails are driven through predrilled holes in the top surface on the last strip (as on the first one). In order to fit the last strip in place, you must cut a slight bevel on the last edge.

The holes for the bench dogs must be bored perfectly perpendicular to the bench top. A drill guide such as the Portalign tool is ideal.

The wooden vise tail is attached after the bench top has been completed. Cut it slightly oversize at the top so it can be planed flush to bench top after installation.

The cabinet/shelf is constructed as a separate unit and attached with screws driven at an angle to gain purchase in the rear-frame verticals. The series of holes for tools should be drilled before the unit is

(Please turn to page 166)

MATERIALS LIST—DAD'S WORKBENCH

Key	No.	Size and description (use)
A	4	1 1/2 × 3 1/2 × 81" fir
B	2	1 1/2 × 3 1/2 × 60" fir
C	2	1 1/2 × 3 1/2 × 57" fir
D	4	1 1/2 × 3 1/2 × 54" fir
E	2	1 1/2 × 3 1/2 × 32 1/2" fir
F	2	1 1/2 × 3 1/2 × 26" fir
G	1	1 1/2 × 3 1/2 × 16" fir
H	2	1 1/2 × 3 1/2 × 5 1/2" fir
I	2	3 1/2 × 3 1/2 × 33 3/4" cedar (leg)
J	3	1 1/2 × 5 1/2 × 57" fir (subtop)
K	1	1 1/2 × 5 1/2 × 16 1/4" fir (vise mount)
L	1	1 1/2 × 3 1/2 × 57" fir (subtop)
M	2	1 1/2 × 5 1/2 × 29" pine (side rail)
N	1	1 1/2 × 5 1/2 × 59 1/4" pine (apron)
O	2	1/2 × 1/2 × 3/4" pine (filler block)
P	as reqd.	3/4 × 2 1/4 × 20 1/2" red oak flooring (top)
Q	1	2 × 6 1/4 × 16" poplar, glued-up nominal 1" stock (vise tailpiece)
R	2	3/4 × 5 1/2 × 17" pine (nailing strips)
S	4	3/4 × 5 1/2 × 16 1/4" pine (nailing strips)
T	1	3/4 × 3 1/2 × 17" pine (nailing strip)
U	2	3/4 × 3 1/2 × 16 1/4" pine (nailing strips)
V	1	1/2 × 33 3/4 × 60" perforated hardboard (backing)
W	1	1/2 × 19 1/4 × 60" hardboard (backing)
X	1	1/2 × 9 1/4 × 60" hardboard (backing)
Y	1	1/2 × 7 × 60" hardboard (backing)
Z	1	1/2 × 9 × 57" hardboard (countertop)
AA	2	1/2 × 1 1/2 × 60" fir (trim)
BB	4	1/2 × 1 1/2 × 30 3/4" fir (trim)
CC	2	3/4 × 8 × 60" pine
DD	1	3/4 × 5 1/2 × 60" pine
EE	4	3/4 × 5 1/2 × 7 1/2" pine
FF	4	1/2 × 5 × 10 1/4" hardboard (upper-shelf doors)
GG	1	3/4 × 18 1/4 × 57" plywood
HH	1	3/4 × 18 1/4 × 21 1/4" plywood
II	1	3/4 × 18 1/4 × 21" plywood
JJ	1	3/4 × 18 1/4 × 21" plywood
KK	2	3/4 × 18 1/4 × 18 1/4" plywood
LL	2	1/2 × 3/4 × 21" pine
MM	2	1/2 × 3/4 × 17 1/4" pine
NN	3	1 1/2 × 1 1/2 × 2" pine (bench dog top)
OO	3	3/8"-dia. × 3 3/4" dowel (bench dog shaft)
PP	1	Woodcraft vise, Model No. 17D03 AW
QQ	1	3/4 × 14" (or to suit) pipe with 2 end caps (vise handle)
RR	2 sets	19 1/4"-length aluminum sliding-door track
SS	4	No. 14 × 2" fn screws
TT	as reqd.	10d common nails
UU	as reqd.	6d common nails
VV	as reqd.	6d finishing nails
WW	as reqd.	4d finishing nails
XX	as reqd.	3/4" galvanized brads
YY	4	3/4 × 3 1/2" lagscrews and washers

Misc.: White glue.



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CRAFTSMAN'S WORKBENCH

(Continued from page 164)

assembled so they can be properly backed up to prevent splintering.

Add the plain and perforated-hardboard panels and border trim. Sand the bench top with a belt sander and ease all sharp corners of the rails by sanding.

Apply a coat of stain and two coats of clear top finish to all raw wood. We used McCloskey Tungseal Light Oak stain and Satin Polyurethane varnish of the same brand.

Building Junior's bench

This workbench, obviously, is a lot easier to build than the one you make for yourself. We've kept construction simple, so that your child can share in the fun and reward of building it.

Start by cutting legs to length. Cut the dadoes to receive bottom crossrails (C). Top crossrails (C) are surface-mounted. Assemble both leg panels using glue and flathead wood screws. Join leg panels with remain-

GREAT SHOP

(Continued from page 148)

those features that especially impressed us. These include new switches for his table saw, the Opfer version of bandsaw doors and a number of clever dust-collecting ideas for power tools.

Not shown are such good work aids as the section of rubber-backed carpet that he keeps on his workbench. The carpet serves as a "third hand" for holding pieces being worked with a portable power tool. It is especially effective for holding small pieces being sanded with a power finishing sander.

Another good idea is putting a piece of conventional carpet between stationary power tools and the wooden floor. Because of that piece of carpet, it is a snap to push a heavy machine, such as the table saw, wherever desired. Yet the tool stays put when it should.

A skilled furniture maker, Opfer enjoys doing for others. A recent task—and a formidable one—was to build four oak-spoked wheels for a friend who is remodeling a Model-T Ford. The task started as a "one-spoke repair job," he says, but the replacement part looked so good to his friend that he wound up replacing "the whole dang set."

That type of service to others pretty much explains the Opfer attitude of sharing his workshop and his skills with others. And that's an attitude that I keep running into when I visit the PM Great Shops. **PM**

ing frame members, parts B and D; then install the plywood shelf (I).

Add the filler strips (J) to the upper rails and install the plywood top and shavings trough.

Check the dimensions of the workbench; then lay out and cut the perforated toolboard. Add the pine boards (R) in back, using glue and flathead wood screws to join the parts. Mount the board to the bench using screws, and add the outside molding to the top and side edges with glue and brads.

Check the dimensions of the toolboard and lay out the parts for the toolboard shelf. Make certain you cut the dadoes for the separators before assembling the shelf unit.

After the unit is assembled, install it on the board using hefty screws through its back and into the pine support strips behind the perforated board (R).

Finally, construct the drawers as shown, sizing each to suit its own opening.

For splinter-free edges, add shelf-edge molding to all exposed plywood edges. Fasten the moldings with glue and countersunk brads. Sand the entire piece.

A finish is not a must on this workbench, but it will hold up better if you give the entire unit two coats of varnish. For color highlight, we applied blue latex paint to the toolboard before the varnish. **PM**

MATERIALS LIST—JUNIOR BENCH

Key	No.	Size and description (use)
A	4	1½ x 3½ x 27¼" fir (legs)
B	2	¾ x 3½ x 38" pine (aprons)
C	4	¾ x 3½ x 17¼" pine (rails)
D	2	¾ x 3½ x 35" pine (stretchers)
E	1	¾ x 1½ x 38" pine (filler strip)
F	2	¾ x 1½ x 15" pine (filler strips)
G	1	¾ x 1½ x 36½" pine (filler strip)
H	1	¾ x 4¼ x 38" plywood (shavings trough)
I	1	¾ x 15 x 38" plywood (shelf)
J	1	¾ x 17¼ x 42½" plywood (counter)
K-1	2	¾ x ¾ x 11¼" pine (shelf edge strips)
K-2	4	¾ x ¾ x 1" pine (shelf edge strips)
L	2	¾ x ¾ x 33½" pine (shelf edge strips)
M	2	¾ x ¾ x 18" pine (shelf edge strips)
N	1	¾ x ¾ x 43" pine (shelf edge strip)
O	1	¾ x ¾ x 43" pine (plywood molding)
P	2	¾ x ¾ x 23¼" pine (plywood molding)
Q	1	¾ x 30 x 42¼" perforated hardboard (toolboard)
R	2	1½ x 2½ x 39¼" pine (supports)
S	1	1½ x 1½ x 43" pine (cleat)
T	2	¾ x 5 x 43" pine (shelf top and bottom)
U	2	¾ x 4¼ x 5" pine (shelf ends)
V	2	¾ x 4¼ x 4¼" pine (dividers)
W	5	¾ x 4¼ x 4¼" hardboard (separators)
X	1	¾ x 4¼ x 42¼" hardboard (shelf back)
Y	2	¾ x 4¼ x 8¼" pine (drawer fronts)
Z	4	½ x 3½ x 4¼" pine (drawer sides)
AA	2	½ x 3 x 7¼" pine (drawer backs)
BB	2	¾ x 4¼ x 7¼" hardboard (drawer bottoms)
CC	8	¾ x 2" carriage bolts with nuts and washers
DD	6	¾ x 2½" carriage bolts with nuts and washers
EE	3	¾ x 1½" fl bolts with nuts and washers
FF	14	No. 10 x 2" fl screws
GG	18	No. 10 x 1¼" fl screws
HH	as reqd.	1¼" ringed nails
II	as reqd.	2" finishing nails
JJ	as reqd.	¾" brads
KK	2	Amerock pulls, No. BP-705-30
LL	1	Stanley vise, No. 81-700
Misc.		White glue, sandpaper, Latex paint, varnish.

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came in for a few grumbles, particularly in the vagueness of the fifth-gear slot and the fact that reverse had no detent.

Overall quality and workmanship received very high marks, with 85 percent of our owners rating them *good to excellent*. A retired auto-parts salesman from Florida searched but, "... I couldn't find so much as a paint flaw. The body is extremely tight and quiet; good insulation and excellent upholstery in the SL series."

A North Carolina systems analyst: "It has excellent quality and far better workmanship than any American car I've ever owned."

"I have had the car for six months," noted an Ohio steelworker, "and have had no problems of any kind with it."

A Mississippi banker: "Everything fits and works the way it's supposed to."

"In this day of plastic cars," concluded a California bookkeeper, "I feel that the Datsun is very well constructed."

Dealer service, as with any car, came in for mixed reviews. About 60 percent of our sampling rated their dealers *good to excellent*, with 40 percent handing them a score of *average to poor*. Here's a cross section of responses:

"At 7000 miles," reported a California retiree, "I asked my dealer about the 7500-mile service. He said they change oil and filter, check the body for squeaks, and adjust the valves. Charge: \$85. I thought this was out of line; so I changed the oil and filter myself (as I've been doing



Cramped rear leads gripe list. Quarter panes open, aid flow-through ventilation.

for years anyway), and the valves will go to 20,000 miles before adjustment."

A California field engineer: "I've bought six cars from this Datsun dealer, and every purchase was absolutely great! The salesman is honest and straightforward. As to service, the car is always returned dirty, with grease and handprints inside, but the problem is always fixed."

A Florida wire processor: "Service is good, but they don't stock enough parts, and I've had to wait three weeks for parts."

We asked owners to suggest ways that Datsun might improve the 200SX. Here's a sampling of pet peeves and constructive comments:

"The hatchback needs a small storage compartment that's hidden. Ideally it would be removable so you could carry things in it—like a box."—North Carolina service planning engineer.

"Change the shift pattern so it's normal, and put a lockout on reverse."—Texas data programmer.

"Either expand or eliminate the rear seat."—California office manager.

"I would like to see the depth of the trunk on the notchback coupe increased so that grocery bags could stand upright."—North Carolina textile worker.

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"The four-wheel disc brakes sound like a good idea, but the pedal has to travel a long way before they take hold. The brakes require a longer-than-necessary distance for stopping. You can't day-dream."—Oregon dispatcher. (Other owners complained of brake squeal.)

"I wish they'd add some sort of lumbar-support adjustment to the front seats [SL models have it—Ed.]; also higher-quality

speakers with the stereo; also an adjustable front-end alignment setup. As it is now, the front alignment is preset at the factory."—California typographer.

Smiles, though, topped frowns by a wide margin, and owners included unsolicited praise for their 200SXs.

"I didn't have to give up luxury, comfort or performance for the fantastic gas mileage I'm getting," beamed an Alabama

secretary. "I guess you realize by now that the Datsun 200SX is the greatest car I've ever owned."

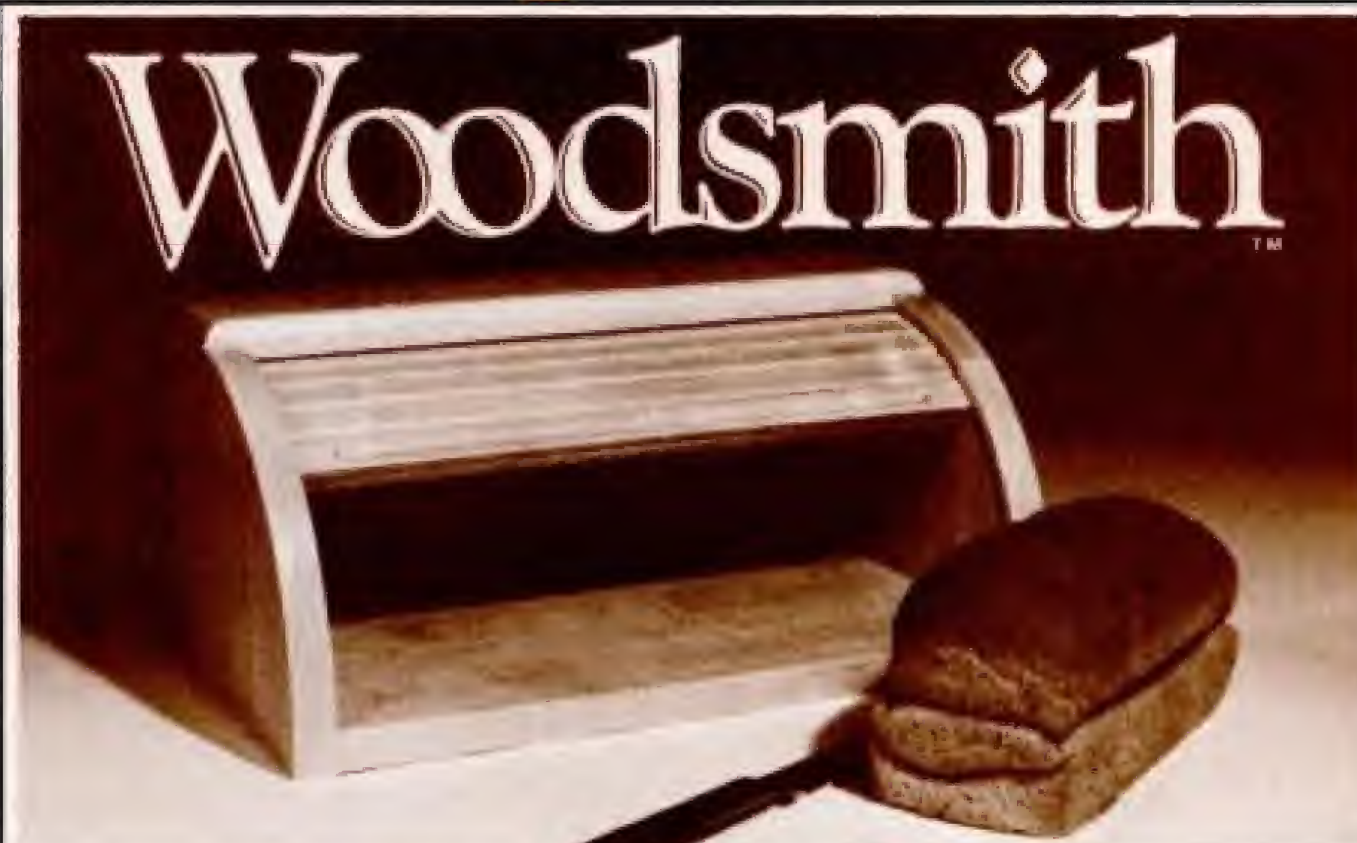
Nearly 92 percent of the 200SX owners we surveyed told us they'd buy another Datsun next time around. Of those, almost 85 percent would choose the 200SX again—the rest would opt for larger models due to growing families. Statistics speak extremely well of all Datsuns. **PM**

SUMMARY OF 1980 DATSUN 200SX OWNERS REPORTS*

Total miles driven 2,174,002	Comfort 24.1	Fair 3.6	Average 19.9
Average miles per gallon	Performance 23.4	Poor 0.4	Fair 7.5
With manual five-speed	Specific dislikes:	Comfort opinion (rear seats):	Poor 13.5
In town 28.2	No complaints 17.9	Excellent 3.7	Number of vehicles owned:
Long trips 36.0	Poor dealer service 10.8	Very good 8.1	Datsun 200SX only 40.5%
With automatic	Tight rear legroom 10.8	Good 17.9	Two cars 45.9
In town 24.9	Unresponsive brakes 8.2	Fair 36.6	Three cars 7.9
Long trips 31.0	Poor seating comfort 7.1	Poor 33.7	Four or more cars 5.7
Transmission choices:	What changes would you like?	Had any mechanical trouble?	Makes of other cars owned:
Five-speed manual 77.3%	More rear legroom 18.1%	No 52.1%	Datsun 23.3%
Three-speed automatic 22.7	No changes 14.7	Yes 47.9	Ford 17.2
Body-style choices:	More comfortable seats 9.4	What type of trouble?	Oldsmobile 12.9
Two-door notchback 58.0%	Better materials 6.8	Mushy, squeaky brakes 14.9%	Dodge 7.4
Three-door hatchback 42.0	More headroom 5.7	Heater 9.7	Chevrolet 5.3
Why did you choose the 200SX?	Better brakes 5.7	Transmission 9.0	Age distribution of owners:
Styling 80.4%	Workmanship opinion:	Oil leaks 7.5	15-29 years 36.8%
Economy 63.8	Excellent 44.6%	Windshield wiper 7.5	30-49 years 48.9
Performance 16.7	Good 40.4	Dealer repairs satisfactory?	50-plus 14.4
Handling ease 9.1	Average 10.0	Yes 58.5%	Would you buy another Datsun?
Price 8.3	Fair 2.9	No 41.5	Yes 91.7%
Specific likes:	Poor 2.1	Dealer service opinion:	No 8.3
Styling 77.0%	Comfort opinion (front seats):	Excellent 24.1%	Would you buy another 200SX?
Economy 76.3	Excellent 45.8%	Good 35.0	Yes 84.9%
Handling 32.8	Very good 36.5		No 15.1
	Good 13.7		

*Percentages might not equal 100% due to rounding or insufficient data.

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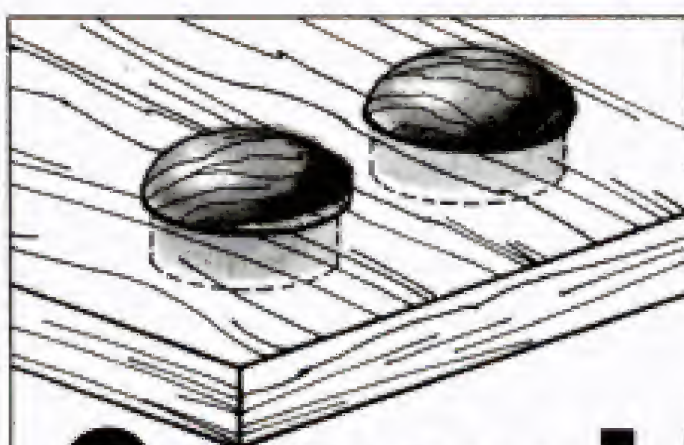
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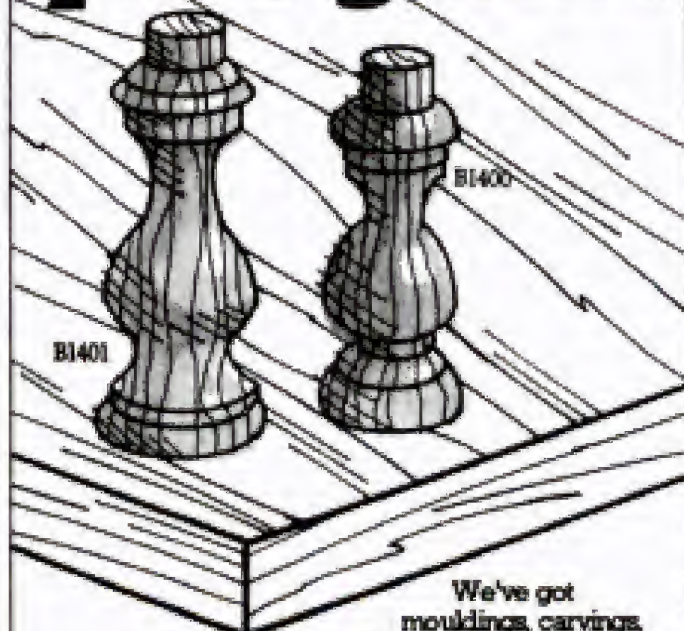


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(Continued from page 136)

5. Remove clamps from glued-up pieces.
6. Cut both legs to length with radial or table saw set to cut at angle shown.
7. Place pattern on legs and draw outline with pencil. Cut legs out using band or sabre saw. Then smooth all edges.
8. Cut mortise in legs (repeat angle used for leg tops and bottoms). Round all edges with a rounding-over bit and router; sand smooth.
9. Round and sand edges of top piece.

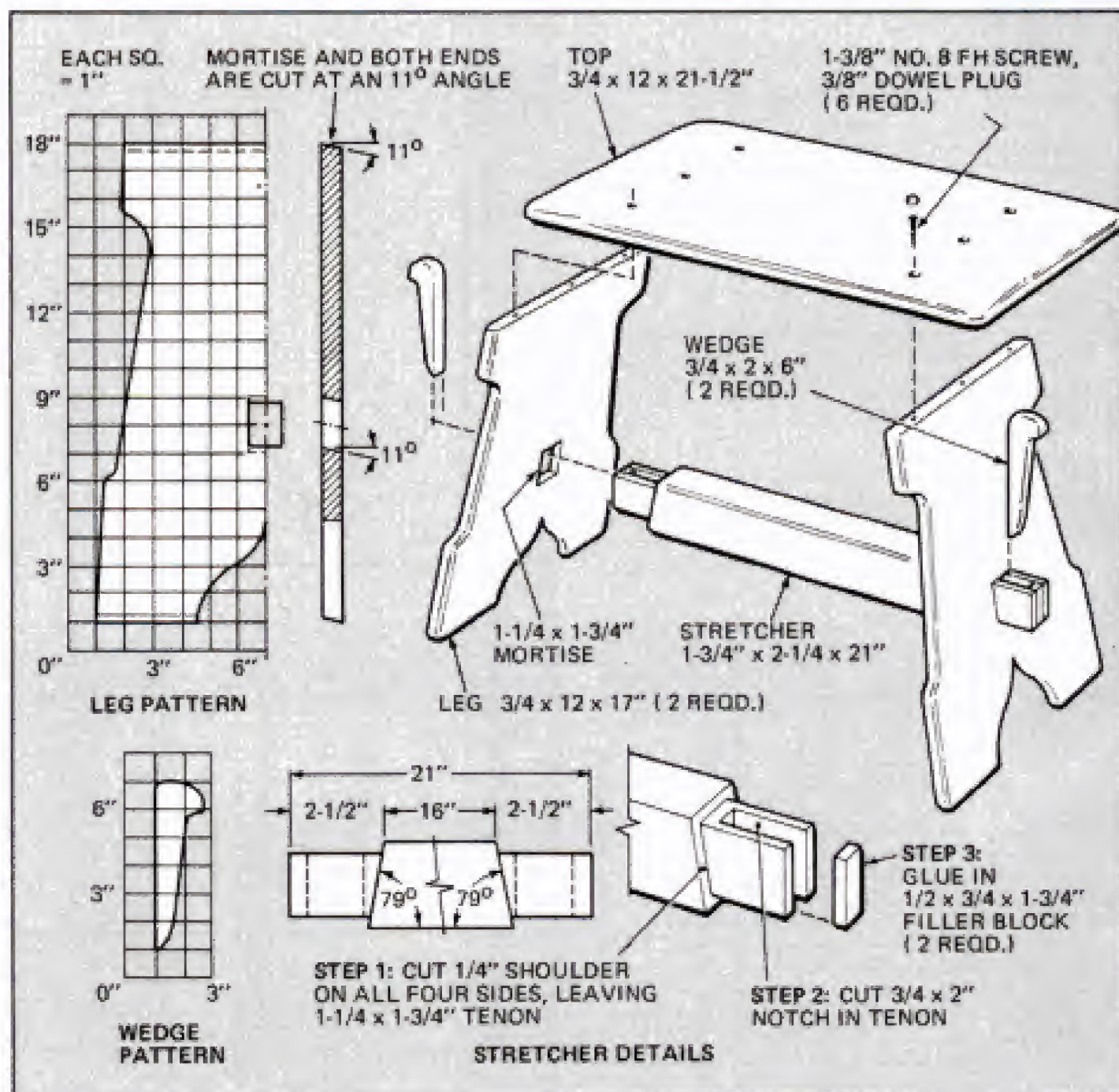
13. When satisfied, disassemble the pieces; make light match marks with pencil.

14. Using glue, assemble legs and stretcher; spread glue sparingly on wedges; drive them securely into stretcher tenons.

15. Next day, apply glue sparingly to leg tops and carefully line up leg assembly with match marks. Again, hold setup together using partially driven finishing nails. Then clamp rigidly.

16. Next day, remove clamps and bore pilot holes with counterbores for top-holding screws. Apply moistened soap to screw threads; turn screws fully home. Put glue on each dowel plug and tap into place.

17. You can distress the piece if desired, but don't overdo it. Raps with a ball-peen hammer and/or smacks with a chain will do.



10. Place top—top surface down—on work surface; carefully locate leg positions. On inside surface of legs, partially drive several 1 1/2-in. finishing nails through legs into top.

11. When legs are positioned, measure between them for cutting ends of stretcher.

12. Cut stretcher tenons—note angle—and insert in temporary assembly to check fit. Adjust and trim.

18. Stain the piece using an oil stain. Wipe as directed; allow to dry.

19. Sand lightly, dust and wipe with a tack cloth. Seal with a coat of 3-lb.-cut, water-white shellac thinned 50 percent with denatured alcohol.

20. Sand lightly after first coat with No. 180-grit paper; dust and wipe with a tack cloth before second coat.

7. "Tinkertoy" chair

You can make one of these chairs, or set up your shop production-style if you want to make a set of four. You need 3/4 maple stock to make the discs. This allows sufficient thickness for the 7/8-in. dowels. Do not use softwood for the round pieces because it tends to split at the thin wall section.

1. Rough-cut the discs with a band or jigsaw; then turn them to size on the lathe. Sand.

2. The holes for the dowels must be bored with accuracy.

So it's best to use a drill press and vise. All holes are bored to a depth of 3/4 in. Note that the front center discs are not interchangeable. So you must be sure to make a left- and right-side disc when laying out the hole centers.

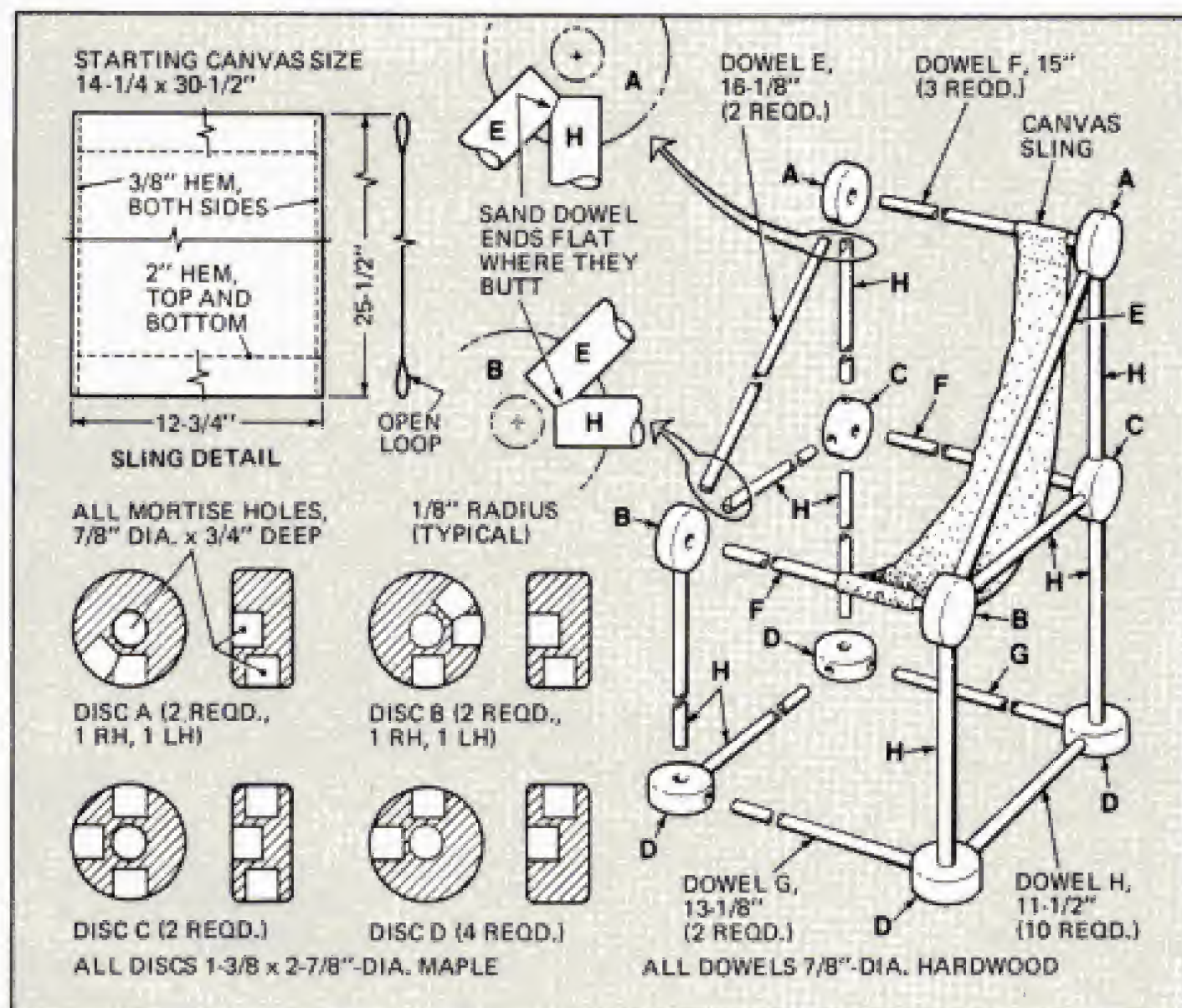
3. Cut the dowels to length, observing that the size of the two bottom dowels (front and



rear) differ from the other three cross members. Sand a slight flat at the ends of those dowels that insert at angles under 90° (front center and top). Insert one dowel into the hole

the cross members until later. When both side sections have been glued, install the cross members dry. This insures that all discs will be in alignment as the glue sets. Before inserting the cross members, check to make sure that no glue has oozed into the side dowel holes. This could happen because the drill-bit point makes a small through-hole. If glue is present, remove it.

5. Prime all wooden parts with shellac and set aside to dry.



and mark the cutoff with a pencil. The ends of both adjoining dowels must be treated this way.

4. Test-fit all parts in a dry assembly. Begin assembly by gluing up the left- and right-side sections, working from the base up. Don't glue

6. Paint the various pieces in a variety of colors as on the original.

7. Cut the canvas to size, using chalk mark for the loops, and take it to the local shoe-repair shop for sewing (unless your wife has a machine that will sew this material).

8. Play tools

If you have a toddler who likes to follow you around the house while you perform house chores, you can promote him to assistant by building this set of duplicates of all his favorite tools. As you can see in the drawings, all construction is simple. Here are construction tips:

1. Cut the slots for both the saw and the try-square blades before cutting the handles to their final shapes.

2. Use a tenoning jig when cutting end slots.

3. Assemble the try square with brads and white glue, but for authenticity, get real 3/4-in. brass saw screws at your local hardware store.

4. The claw half of the hammer head and the wrench are cut out on a bandsaw. Before you cut the final claw shape, bore the assembly holes. Assemble head dry and finish with two coats of spray paint. When paint is dry, disassemble head, dab on some glue and insert handle. Reassemble permanently.

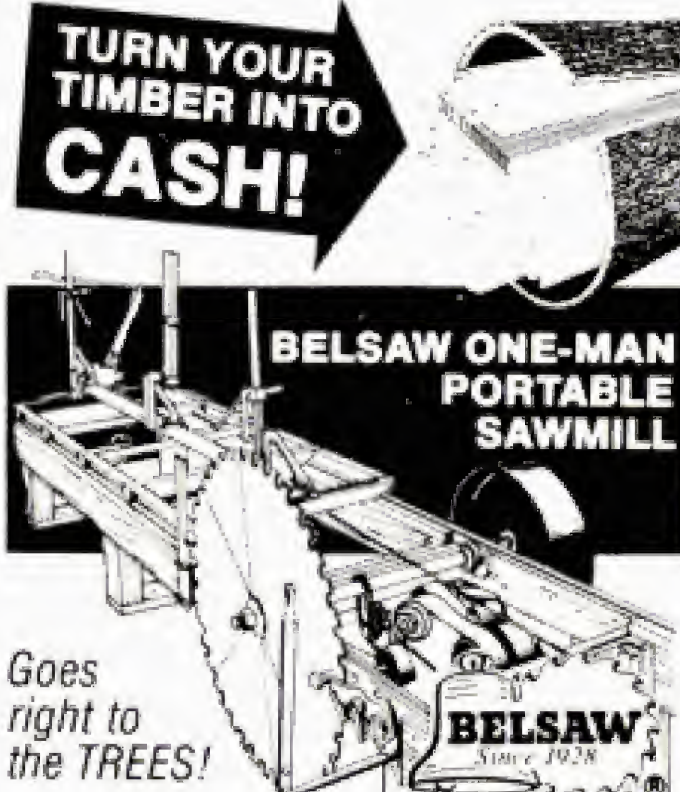
5. To shape the screwdriver, you need a lathe and a belt sander. Our version is sized so that you can use a 6-in. lathe (like Dremel's Mini-Lathe) to turn the shank and flared tip. Sand the flats on the blade with a belt sander.

6. The toolbox itself is straightforward and simple. If a lighter version is preferred, you can substitute 1/2-in. pine for the 3/4-in. stock and adjust dimensions accordingly. Paint the perforated board before assembling the box and break all sharp wood edges with sandpaper. Round the outer edges of the center panel frame with a 1/4-in. rounding-over bit and router. Assemble with white glue and nails.

7. The toolbox shown was left natural and finished with two coats of polyurethane varnish.

When the varnish is dry, install the saw-holding turnbuckle. Use epoxy adhesive to hold the perforated-board hooks in place—and out of the mouth of the child.

(Please turn to page 172)



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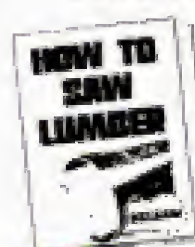
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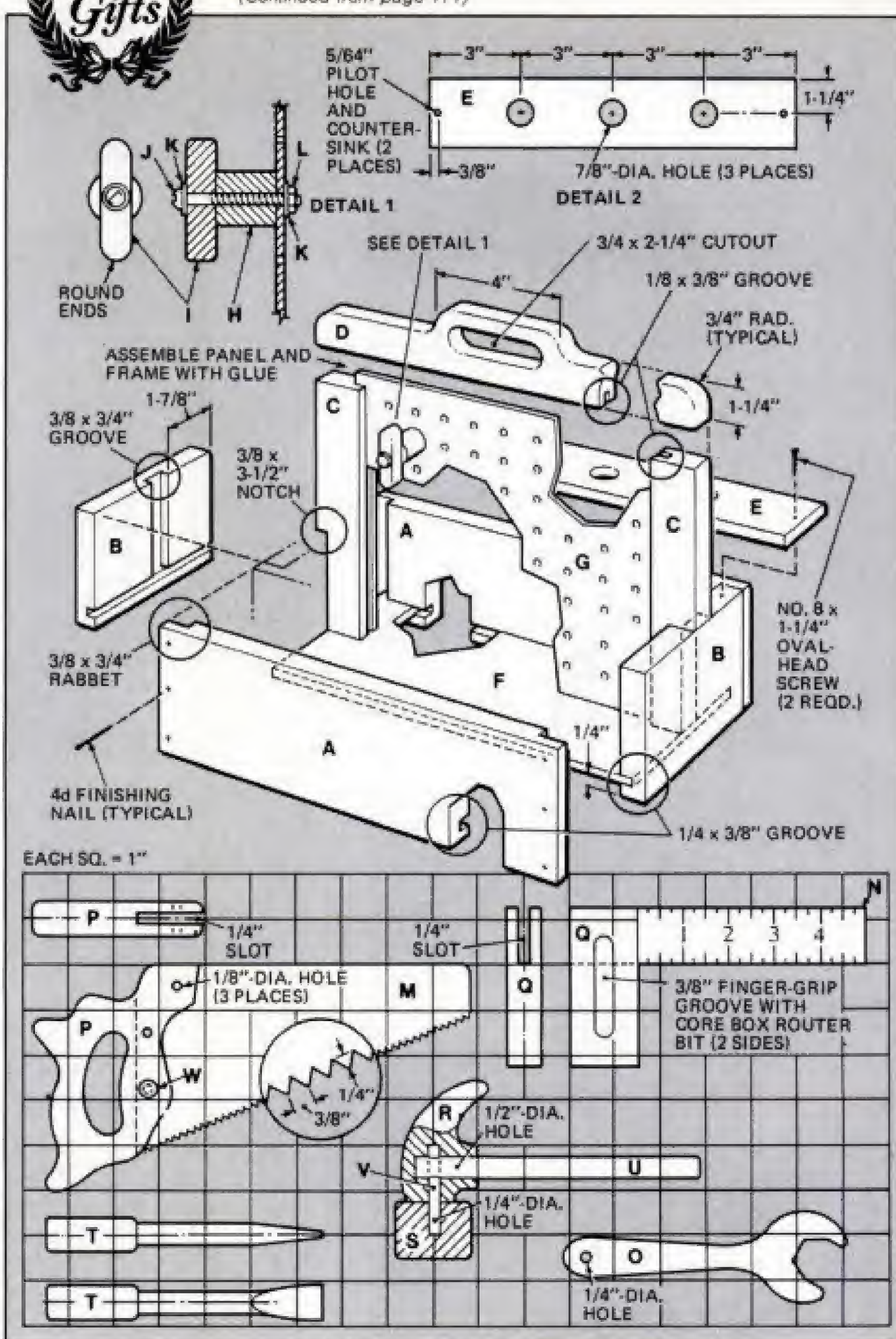
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(Continued from page 171)



MATERIALS LIST—TOOLBOX

Key	No.	Size and description (use)			
A	2	3/4 x 4 x 12" pine (sides)	N	1	1/4 x 1-1/4 x 8-1/2" veneer core plywood (try square blade)
B	2	3/4 x 4 x 5-1/4" pine (ends)	O	1	1/4 x 2 x 7" overall, veneer core plywood (wrench)
C	2	3/4 x 1-3/4 x 8-1/2" pine (vertical frame)	P	1	3/4 x 4 x 5" pine or oak (saw handle)
D	1	3/4 x 2-1/4 x 12" pine (horizontal frame)	Q	1	3/4 x 1-1/2 x 3-1/2" pine or oak (square handle)
E	1	1/2 x 2-1/4 x 12" pine (toolrack)	R	1	1-1/4 x 2 x 3" overall, oak (hammer head, claw and cheek)
F	1	1/4 x 5-1/4 x 11-1/4" hardboard (bottom)	S	1	1-3/4" dia. x 1-1/4" oak (hammer head, poll)
G	1	1/8 x 8-1/4 x 10" perforated hardboard	T	1	1/4" dia. x 6" hardwood dowel (screwdriver)
H	1	3/8" dia. x 1" dowel (spacer)	U	1	1/2" dia. x 6-1/4" hardwood dowel (hammer handle)
I	1	1/2 x 1/2 x 2" turnbutton	V	1	1/4" dia. x 2" hardwood dowel (hammer pin)
J	1	3/16 x 1-1/4" machine screw	W	3	Brass paper clips
K	2	3/16" washers			
L	1	3/16" hex nuts			
M	1	1/4 x 5 x 7-1/2" overall, veneer core plywood (saw blade)			

9. Oak coffee table

For looks, our contemporary table was created of red oak, left natural and simply varnished. Other wood can be substituted, if desired and available. But, because there is no stretcher in this design, we recommend avoiding softwoods such as pine because they aren't rigid

enough. To keep down costs, buy 2-in. nominal oak and rip the pieces to size.

1. Check the thickness of the oak and rip the plank into strips of the same width. If, for example, your oak stock is 1 7/16 in. thick instead of

(Please turn to page 178)

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1938 Cadillac Convertible silver miniature illustrated above is approximately five times actual size to show fine detail.

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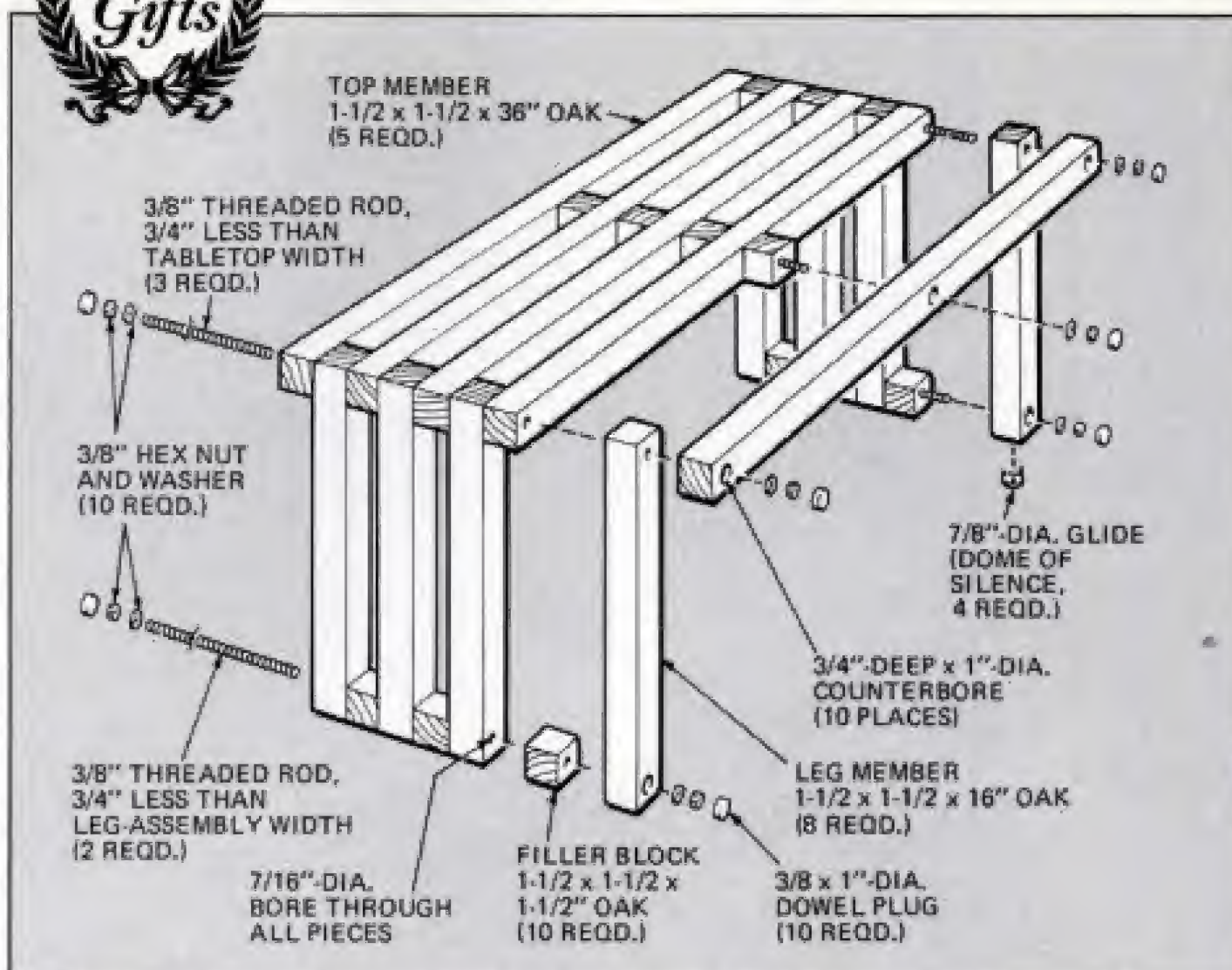
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(Continued from page 172)



the full 1 1/2 in., rip the strips 1 7/16 in. square. For looks, if any edge requires planing, plane the same amount of stock from the face of one of the perpendicular surfaces to maintain the square. All strips should be exactly the same dimension.

2. Cut strips for top and legs to length.

3. Cut the 10 filler blocks.

4. On a large work surface, line up the parts as they will be assembled in the finished table. At this time, make certain that the wood grain of all boards is similar. On the table shown, the face grain (of the original board) is on the outside surface all around—the horizontal surfaces of the top slab and the vertical surfaces of the legs.

5. Carefully mark all boards for the holes to be bored through for the threaded rod. Bore the holes through all pieces.

Note: Before boring holes in any of the pieces, make special marks on the outside strips—there should be 10 marks in all—for the holes to be counterbored to receive the plugs. Counterbore 3/4 in. deep before boring the 7/16-in. hole in all remaining boards.

6. Line up all strips and filler blocks on a large work surface. Also, have the precut threaded rods, washers, nuts, glue and the two socket wrenches handy.

7. Assemble the top strips and both legs using glue sparingly between strips and blocks. Slide a rod through each strip as you add it.

8. When all parts are assembled, slip the washers over both ends of all threaded rods and run the nuts just finger-tight.

9. Working one end at a time, rotate the leg upright and check the angle with a square (it must be 90°). Temporarily hold the leg in the correct position using props or hand-screw clamps.

10. Repeat for second leg.

11. When both legs are square to the top, use seven or more bar clamps (at least one at each threaded rod) to pull the boards together tightly.

Do not tighten the nuts now. Allow the setup to rest undisturbed for 24 hours.

12. Next day, before removing clamps, tight-

en the nuts using wrenches and glue in the dowel plugs.

13. Remove clamps. With a sharp chisel, carefully scrape off all hardened glue squeeze-out. Sand the piece thoroughly using first 80-, then 120-grit sandpaper. Finish with 150-grit.

14. Dust with a brush and apply natural-paste wood filler (to fill the oak's open pores). The general procedure is to thin the filler to the consistency of light cream using turpentine. Brush it on a small area at a time, and when the liquid loses its sheen, wipe it off.

When wiping, the best procedure is to first rub across the grain to pack the pores, then with the grain to clean off the excess. Allow to dry at least 24 hours.

15. Finish with two coats of satin-finish varnish, sanding lightly between coats with 180-grit paper. Install the four glides (to prevent any rocking action).

10. Contemporary mirror

This project is a good example of less being more. We used supersimple construction techniques to create the rounded corners.

1. Cut clear pine stock to 2 1/2-in. width.

2. Lay out and assemble the frame using dowels at all four corners. Use glue to assemble and clamp the setup after checking corners for square. Tack diagonal bracing to the frame (on the back side) to keep it square during clamping. (**Note:** You can also clamp the four frame members and then secure the corners using corrugated fasteners or Scotch connectors—two per corner—on the back side.)

3. While the setup is still clamped, apply glue sparingly to the four filler blocks and position them at the four corners. These are held with glue only. So clamp them securely once they are positioned. Allow the setup to dry overnight.

4. Next day, remove clamps and scrape off



all glue squeeze-out using a sharp chisel. Sand the frame, stroking the paper with the grain on each side. Start with 80-grit paper, move up to 120-grit, then finish with 150-grit.

5. Draw one corner of the pattern (of the inside and outside corners) on a scrap piece of thin plywood or hardboard; cut out the corner pattern using a band saw or sabre saw. Sand the pattern edges smooth. Make registration marks for lining up the pattern at each of the frame's four corners.

6. Transfer shape to frame and cut out all four corners, inside and out, using band, jig- or sabre saw.

7. Sand all edges smooth.

8. Shape the inside and outside frame edges

on the front, using a 1/2-in. rounding-over bit in a router.

9. Switch to a 3/8-in. rabbet cutter and, on the back side, cut the rabbet to receive the mirror. Using a ruler and pencil, run the lines out for the corners and cut square corners in the rabbet using a sharp chisel. Measure length and width of rabbets; then deduct 1/8 in. in width and length and order the mirror to suit.

10. Dust, wipe with tack cloth and apply prime coat of paint.

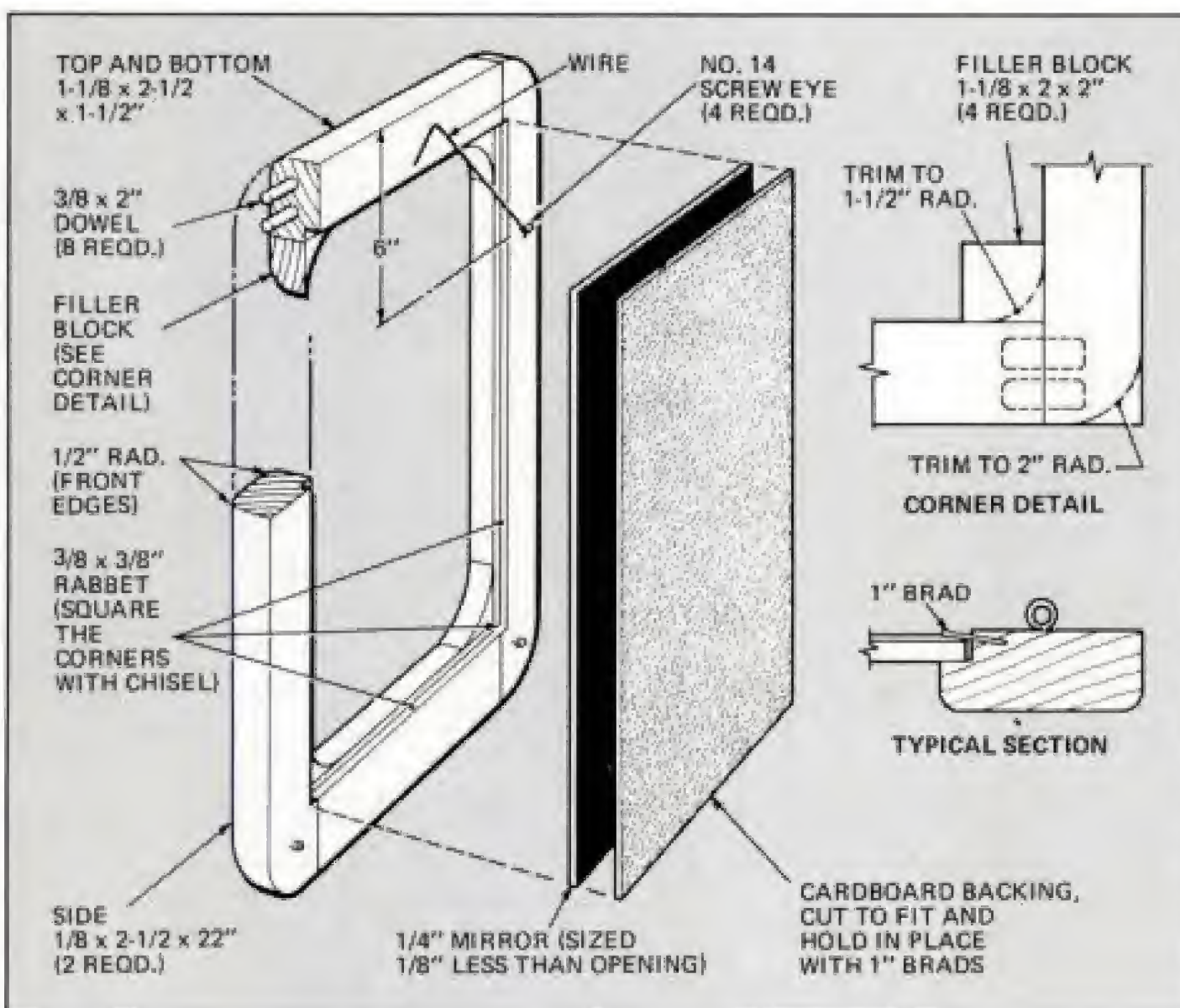
11. Finish with the color of your choice.

12. When dry, place mirror on a soft surface so paint won't be marred, and install screw eyes and picture wire.

In order to keep the mirror from tilting in at the bottom, install a pair of screw eyes near the bottom edge.

13. Insert the mirror and back it up with a piece of cardboard. Use 1-in. brads to hold cardboard and mirror in the frame.

14. Hang the mirror from a stout picture hanger.



11. Clown pull toy

This toy is fun to build and out of the ordinary. Toddlers will roar their approval of the clown jumping over his "rope" of straws. Built mostly of scraps, it's easier to make than you might suspect.

1. Lay out the basic body on white pine. While it is still in block form, mark the locations of the dowel axle holes and stop-drill into each side (so the drill bit will penetrate into what will be a cavity).

2. Carefully cut out the body outline and cavity.

3. Cut all remaining parts to size as shown (see the artwork and the materials list on page 180). The leg block is cut from the same solid pine block as the body.

The bent coat-hanger-wire suspenders are

anchored into the leg block with Wonder Glue. Simply pile the glue around the inserted wire.

4. Cut the 1/4-in. plywood side pieces and glue in place. Round them evenly so that the metal cowling will form properly.

5. Lay out and cut cam. Secure cam to the 1/2-in.-dowel axle with a countersunk screw through the short distance of the cam into the axle.

The cam used will give about 3/4-in. lift. Make certain you allow enough room below the block for the legs to drop and rise without binding.

6. Construct the carriage as shown (following page) and bore the holes with the carriage sides together to assure axle alignment.

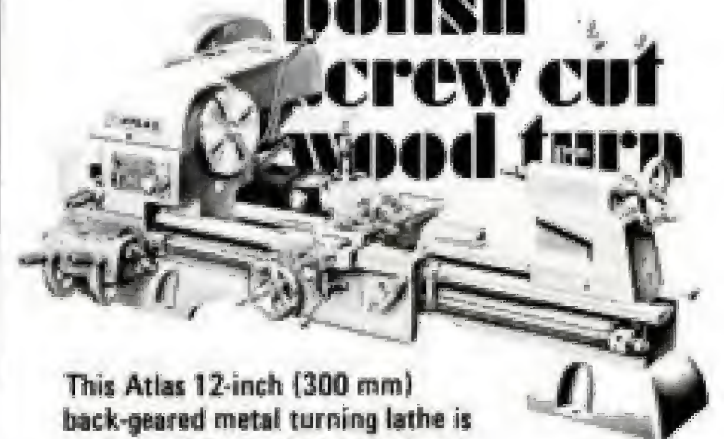
(Please turn to page 180)

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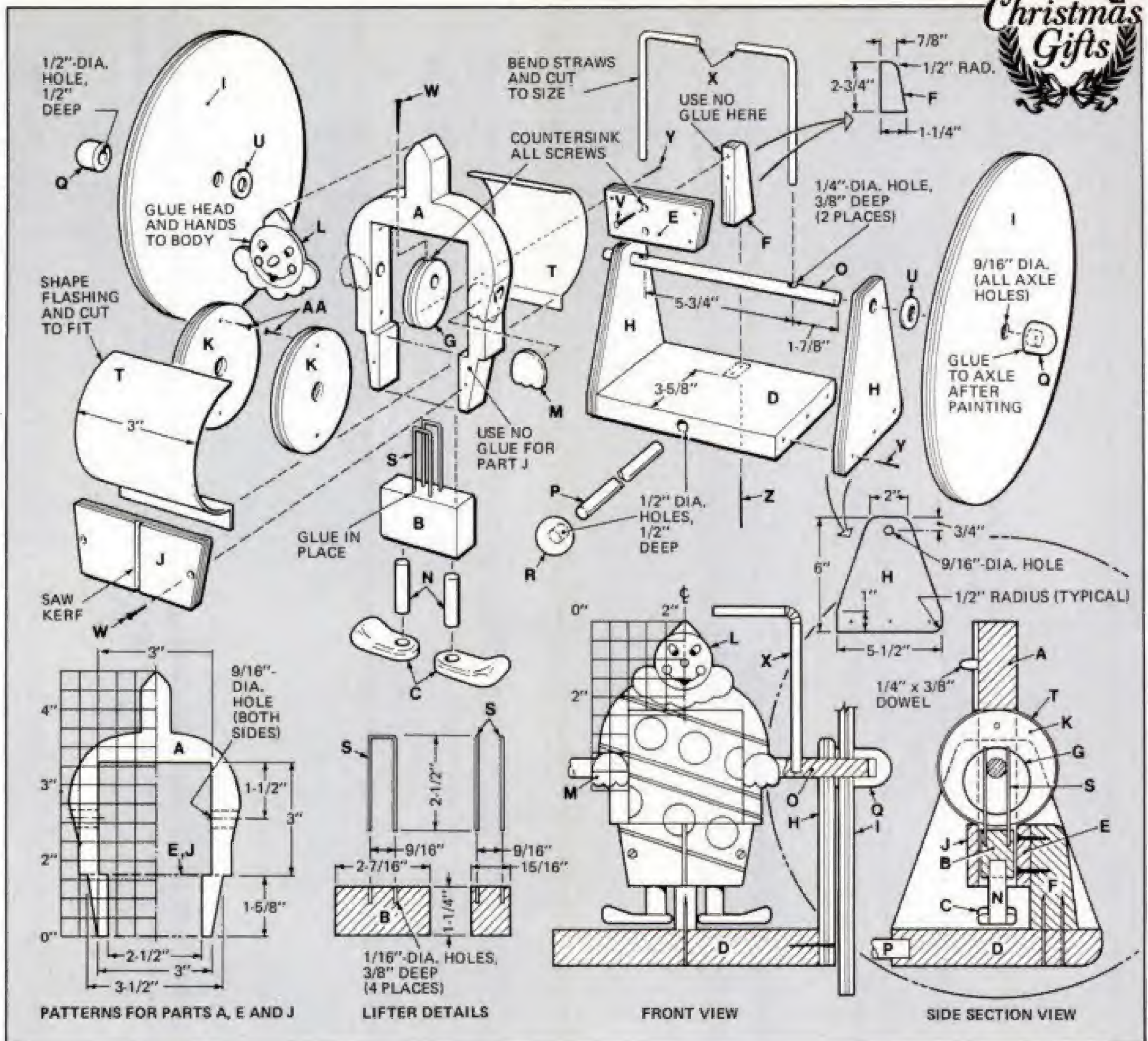
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(Continued from page 179)

- Assemble the carriage pieces.
7. Cut the wheels from $\frac{3}{8}$ -in. plywood stock.
 8. Lay out all holes along the axle. Note that two axle covers keep the axle in place.
 9. Cut the stomach metal cowl from aluminum flashing.
 10. To get working parts assembled, remove one or both of the aluminum covers and insert axle carriage sides under wire suspender.

Insert axle through the cam hole and out through the other side. Then turn the cam screw home.

Attach cowl cover (or covers).

11. Sand all the parts smooth and paint them using the color photograph on page 130 as a guide.

Be careful when you are painting the axle; paint buildup at the axle ends will cause binding.

MATERIALS LIST—CLOWN TOY

Key	No.	Size and description (use)	M	2	$\frac{1}{4}$ " hardboard (hands)
A	1	1 x 5 x 7" overall, pine (body)	N	2	$\frac{1}{2}$ " dia. x 1- $\frac{1}{4}$ " dowel (legs)
B	1	1 $\frac{1}{4}$ x 1- $\frac{1}{4}$ x 2- $\frac{7}{16}$ " pine (leg block)	O	1	$\frac{1}{2}$ " dia. x 9- $\frac{1}{2}$ " dowel (axle)
C	2	$\frac{1}{2}$ x 1 x 2" overall, pine (feet)	P	1	$\frac{1}{2}$ " dia. x 24" dowel (pull rod)
D	1	1 x 5- $\frac{1}{2}$ x 7" pine (carriage base)	Q	2	1" dia. x 1" dowel (axle cover)
E	1	$\frac{1}{2}$ x 1- $\frac{1}{4}$ x 3- $\frac{1}{2}$ " plywood (back support)	R	1	1- $\frac{1}{2}$ "-dia. wood ball (pull handle)
F	1	$\frac{1}{2}$ x 1- $\frac{1}{4}$ x 2- $\frac{3}{4}$ " overall, plywood (back brace)	S	2	6" lengths of coat hanger (lifters)
G	1	1- $\frac{3}{4}$ " dia. x $\frac{1}{2}$ " plywood (cam)	T	2	3 x 6" aluminum flashing (belly)
H	2	$\frac{3}{8}$ x 5- $\frac{1}{2}$ x 6" overall, plywood (carriage sides)	U	2	$\frac{1}{4}$ " washers
I	2	12" dia. x $\frac{3}{8}$ " plywood (wheels)	V	2	No. 8 x 1- $\frac{1}{4}$ " th screws
J	1	$\frac{1}{4}$ x 1- $\frac{1}{4}$ x 3- $\frac{1}{2}$ " overall, plywood (pants)	W	3	No. 6 x $\frac{1}{4}$ " th screws
K	2	3" dia x $\frac{1}{4}$ " plywood (stomach discs)	X	2	straws with a flexible joint
L	1	$\frac{1}{4}$ " hardboard (face)	Y	10	3d finishing nails
			Z	2	6d finishing nails
			AA	4	$\frac{1}{4}$ " brads

12. Rolling pin

Though this pin isn't quite an antique, it is likely that the original first appeared about 60 years ago. Because of its appealing shape, I purchased it at an antique shop and created the replica shown on a lathe using poplar from my shop scrap bin. If yours will be used for its intended purpose, rather than just a wall hanging, you might consider substituting maple.

1. If you don't have wood thick enough for turning the pin, glue up stock to size.

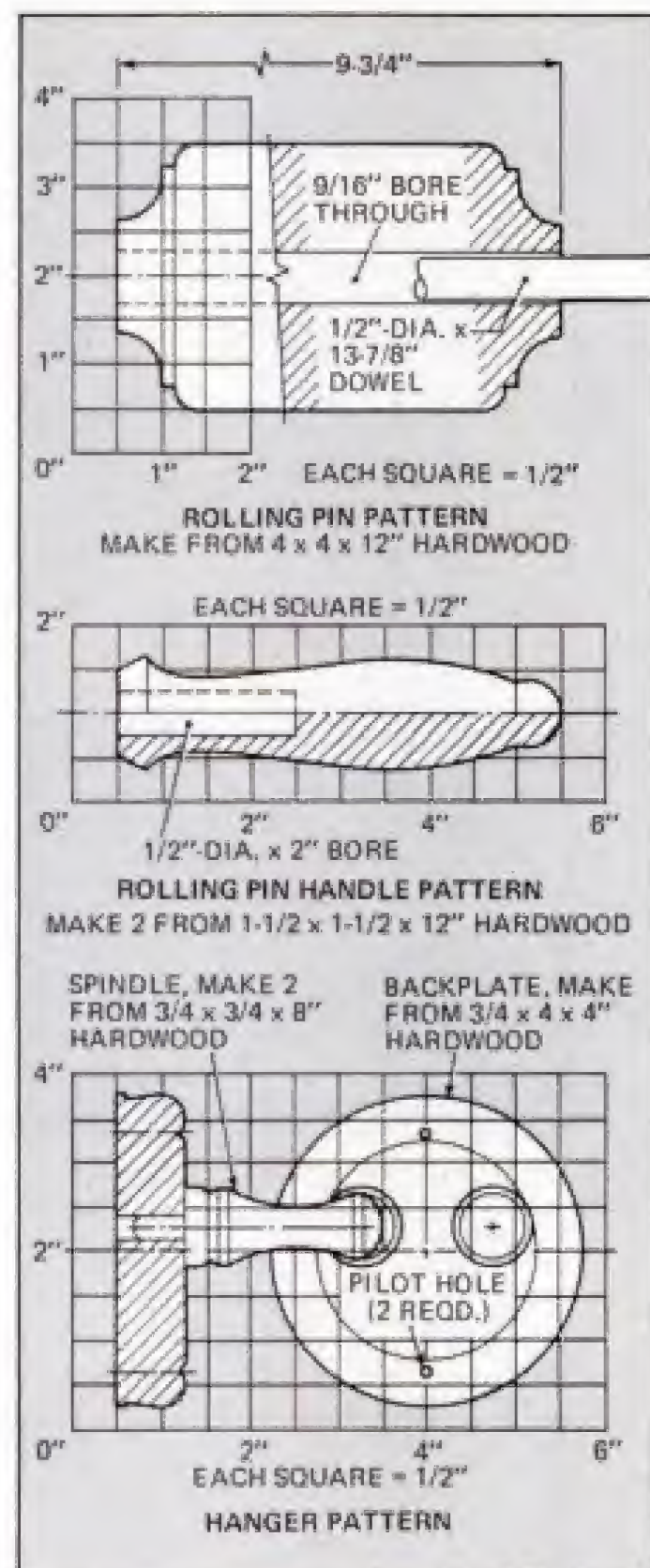
2. Before mounting the block in your lathe, locate the block center at both ends and bore the $\frac{9}{16}$ -in. hole through to receive the dowel. The pin shown was bored on the drill press using a bit extension, but you can mount and bore it on your lathe. Either way, mark accurately and bore with either press or lathe at a low speed. Glue a short length of dowel into the waste area at both ends so that the piece can be mounted for turning.

3. Turn the pin to dimensions shown in draw-



ing. Finish the rolling portion with the skew for a perfectly smooth finish. The ends are shaped with the half-round chisel and diamond point. Sand if necessary. Remove from lathe and cut off waste portions.

4. Next, mount a block in the lathe and turn both handles. Turn the handles using a gouge, skew, half-round chisel and diamond point.



5. The balls at the tips of the handles must be finished by hand. Remove the turning from the lathe and cut off the waste, using a band or jigsaw.

6. Shape balls using file and sandpaper.

7. Insert the length of 1/2-in. hardwood dowel through the pin, add a touch of glue to one end and insert it into one of the handles. Put glue on the other end and add the second handle.

8. If the pin is to be used as a wall decoration, turn the hanger backplate and two spindles of the same wood. Bore the pair of holes and insert the pin tenons. Bore two shank holes through to receive the 1 3/4-in. No. 8 roundhead brass screws.

9. Finish pin and hanger using Salad Bowl oil finish (two coats). (Note: Salad Bowl finish is available from Constantine, 2050 Eastchester Rd., Bronx, N.Y. 10461.)

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9 woodworking secrets

(Continued from page 119)

Super circle-cutting jig

Use this circle cutter to make small-diameter toy wheels, gear blanks and the like. The jig rests on a bandsaw table and is engaged by a bar (D), in the miter groove and a stop (C), against the table edge. The workpiece rotates on a pivot pin (E) which can be positioned as required by diameter. A thumbscrew (F) locks the sliding bar (B) after the desired radius is determined.—Walter N. Fritts

MATERIALS LIST—JIG

Key	No.	Size and description
A	2	1/4 x 16 x 18" plywood
B	1	1/4 x 1 x 8" aluminum flat stock
C	1	1/4 x 1 x 1 1/4" aluminum flat stock
D	1	1/4 x 1/4 x 14" aluminum flat stock
E	1	10-32 screw (position as required)
F	1	1/4-20 x 3/4" thumbscrew
G	1	1/4-20 x 1 1/4" thumbscrew and washer
H	2	1/4-20 Teenut
I	2	No. 8 x 1/2" th wood screw
Misc.: White glue.		



Slide bar with pivot pin can be adjusted to cut very thin sections. Strip being cut is less than 1/16-in. thick.



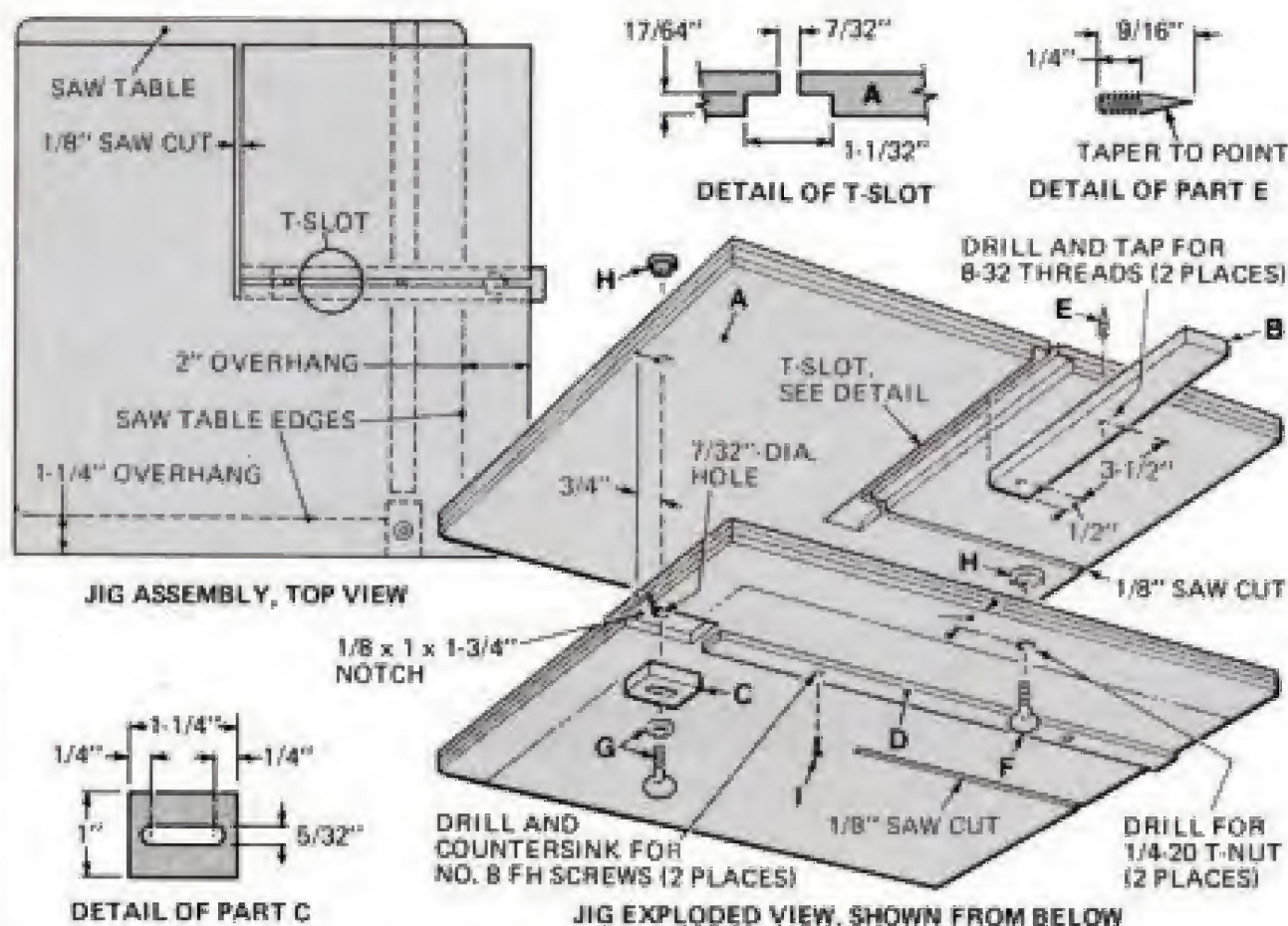
Counterbore hole for Teenut so top of nut is flush to surface. Install Teenut before gluing two boards together.



Make 1/8-in. blade-entry kerf after T-slot has been cut and boards glued together. Use handsaw to finish cut.



When cutting, stop C may be adjusted to correct tracking of blade. Use 1/8-in. blade for diameters less than 3 in.



9woodworking secrets

Two miter clamps.

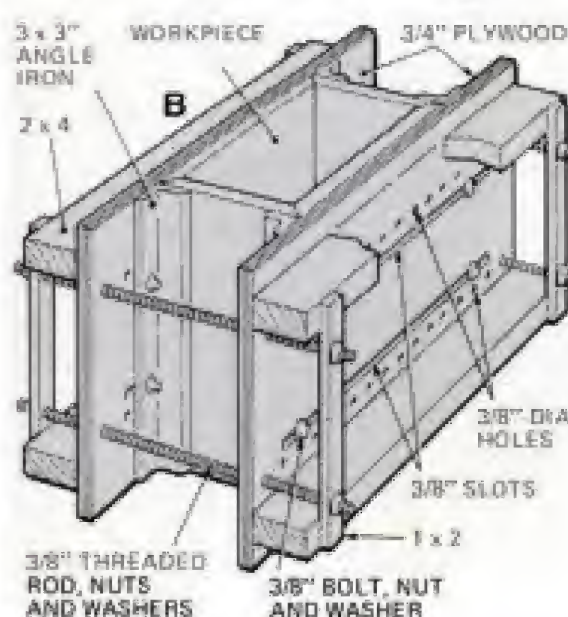
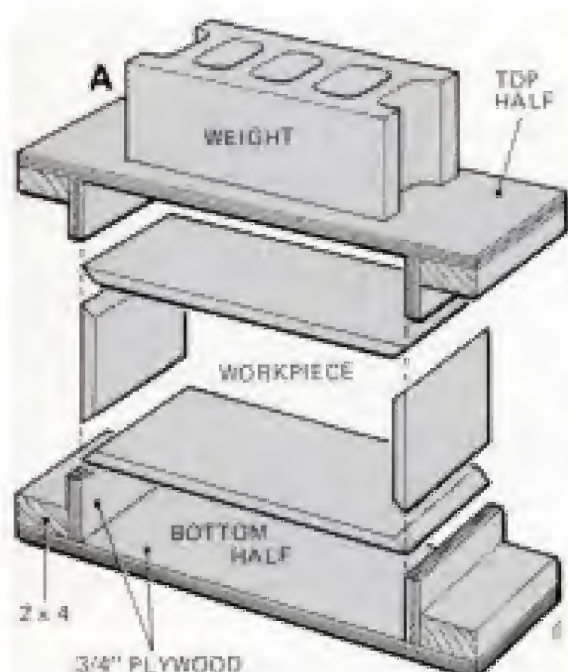
Clamping and gluing 90° miter joints, such as those used for speaker enclosures and wooden boxes, is difficult because force is needed in perpendicular directions. One simple solution is the upper jig shown below. It can be built quickly of scrap wood to suit the task at hand. Use a bucket of water, a cinder block or a couple of full gallon paint cans to provide the pressure.

The improved version (bottom) is



Clamping jig (above) must be sized to project, unlike adjustable jig.

adjustable and is a handy item to keep around the shop. It uses threaded rods to provide clamping pressure and does not need weights.—Thomas Gibson



(Please turn to page 184)

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9 woodworking secrets

Sturdy joint for deck railing

Here's a good method for assembling a 4x4 railing—it's neater than nailing and holds better. As the lumber weathers and dries out, the lagbolts can easily be drawn tighter to keep the joints closed.

Using a square to guide the drill, bore bolt holes. Mark the location for

the intersecting hole for the nut. Tape the drill bit to guide its depth and bore second hole (large enough to permit insertion of a nut and washer). Tighten the bolt firmly. Once the washer bows under pressure, it will prevent the nut from turning and will lock it firmly in place.—J. Edwards



Clever way to join 4x4 deck railing or fencing is neater method than nailing.



After notches are made, assemble and bore bolt hole through rail into post.



Mark location for nut hole, aligning center with the threaded bolt portion.



Bore nut hole perpendicular to bolt hole. Use tape marker as depth guide.



Insert nut and washer into hole (1-in. dia. for 1/4-in. bolt); thread on bolt.



Tighten up the joints with wrench only after all members are in position.

9 woodworking secrets

Homemade faceplate

The metal hub of a saucer-type grinding disc can be converted to a faceplate for turning wood discs on a metal lathe. Wearing goggles, chisel away the ring of metal rolled over the abrasive in the center of the disc. When enough metal has been removed, a few raps on the disc will separate it from the hub. Also remove the epoxy in the hub with a chisel.

Any damage to the hub's threads is corrected by starting a $\frac{1}{8}$ -11 tap from the healthy end. Drill three or four equally spaced holes in the flange for workpiece fastening screws. Then select a short $\frac{1}{8}$ -11 bolt and hacksaw off all but $\frac{3}{4}$ in. of threads and $1\frac{1}{4}$ in. of shank. Screw into hub.—George Obradovich



Drill equally spaced holes in flat area of the flange after center has been completely cleaned out.



Screw the faceplate to the work. Then saw off the head and tail of a $\frac{1}{8}$ -11 bolt to serve as the shaft.



Screw bolt into hub and faceplate is ready to use. Secure the shank in a universal chuck for turning.

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When we asked what aspects of their cars Corvette owners like specifically, the following came up as representative.

"The Vette handles like a dream, and the styling for 1980 is the best by far. I feel, too, that the 14 to 17.5 mpg I'm getting from the 305 V8 and automatic is very good for a sports car."—Louisiana salesman.

"Macho image. I previously had a 1969 Corvette and enjoy driving this type of car tremendously. It has looks, performance, handling and a tremendous image."—Minnesota feed-mill owner.

"I'll never be able to justify this car economically, but I bought it anyway. I especially like the styling—everyone looks at it. Also the handling—it hugs the road. But the ride isn't as stiff as in previous years. And it's just fun to drive!"—Texas gas-and-oil merchant.

"It's a great performer, with quick, responsive handling and super styling."—Wisconsin Olds-Cadillac salesman.

An Ohio industrial engineer: "This is my sixth Corvette. It's the only American GT, and it includes the advantages of good fuel mileage in a performance package,



The 8.4-cu.-ft. luggage compartment has limited space. That means traveling light.

great handling, solid resale and a fiberglass body that doesn't rust. My wife and I love sporty cars."

The Corvette's seats and interior have been revised slightly for 1980, and most

owners seemed more than pleased with the car's comfort.

A Tennessee account executive: "Seats are great. You sit in them, not on them." And a Michigan draftsman: "Getting better—the new seats are a step in the right direction."

But a minority disagreed. An Ohio deputy sheriff complained: "On my older Vettes (1976-77), I could adjust the seat-back angle. On this new one, I had to put shims under the rear floor bolts to change the angle of recline."

Dealer service hasn't changed at all in the last three years since our previous Corvette survey. It rated about average in 1977 and remains so today. More than half the Corvette owners we queried listed mechanical problems that needed dealer attention, and of those, just over half weren't properly repaired the first time.

"It took the dealer three days to replace our starter and flywheel," grumbled a New York tire-store owner. "This came after a lot of runaround. The Corvette has no status at the Chevy dealership—they treated us like we owned a Nova."

A New York architectural contractor shared this little vignette: "I showed the mechanic how my hood didn't match my



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fenders, and he laughed and said, 'Are you kidding? Yours is good. You should see other Vettes.' I couldn't believe it."

And a retail-store owner from Ohio observed, "My dealer's service people work reluctantly, at best."

Again, the typical Corvette owner might expect more from his dealer than owners of more prosaic cars.

When we asked for general overall suggestions for improving future Corvettes, we logged these responses:

"The rear glass should lift like a hatch," recommended a Michigan technician. "Turbocharging and fuel injection would aid performance and fuel economy," proposed a Wisconsin manager. An Ohio salesman: "The 85-mph speedometer is a joke. Let's get back to the 140-mph speedo we had before."

"They should offer a convertible again," said a Tennessee physician.

A North Carolina medical technologist came up with a valid argument when he

jotted on the back of his questionnaire: "Corvettes are wonderful automobiles. However, Chevrolet has just about priced this car out of the marketplace. The craftsmanship and quality are poor for what you pay. Out of the last seven Vettes I've owned, only one had an acceptable paint job. I'd say this 1980 model would be a good value at around \$11,000."

Finally, from a Michigan safety director: "Everyone," he mused, "should own a Corvette once in his lifetime." **PM**

SUMMARY OF 1980 CHEVROLET CORVETTE OWNERS REPORTS*

Total miles driven 808,546	Specific likes:	Comfort opinion:	Fair 13.9
Average miles per gallon	Styling 88.8%	Excellent 31.6%	Poor 18.2
305-cu.-in. (5.0-liter) V8	Handling 51.8	Very good 37.9	Number of vehicles owned:
In town 13.9	Performance 27.6	Good 22.4	Corvette only 16.2%
Long trips 17.4	Resale value 12.4	Fair 6.3	Two cars 46.2
350-cu.-in. (5.7-liter) V8	Comfort 6.5	Poor 1.7	Three cars 27.7
In town 13.7	Specific dislikes:	Had any mechanical trouble?	Four or more cars 9.8
Long trips 17.5	Poor finish and paint 33.5%	Yes 54.7%	Makes of other cars owned:
Engine choices:	Workmanship below par 32.3	No 45.3	Chevrolet 57.2%
305-cu.-in. (5.0-liter) V8 43.8%	Quality of materials 15.2	What type of trouble?	Cadillac 15.9
350-cu.-in. (5.7-liter) V8 56.2	Rattles and noise 12.2	Oil leaks 15.1%	Ford 12.4
Transmission choices:	No complaints 8.5	Transmission 12.9	Pontiac 11.0
Automatic Three-speed 88.8%	What changes would you like?	Air conditioner 11.8	Buick 9.0
Manual Four-speed 11.2	Better workmanship 16.6%	Power steering 10.8	Oldsmobile 9.0
Why did you choose the Corvette?	Better materials 16.6	Electrical 9.7	Age distribution of owners:
Styling 59.9%	Better finish and paint 15.9	Dealer repairs satisfactory?	15-29 years 29.2%
Past experience 24.0	Different styling 8.9	No 51.3%	30-49 years 60.7
High resale value 19.8	Better fuel mileage 8.3	Yes 48.8	50-plus 10.2
American-built sports car 14.4	Workmanship opinion:	Dealer service opinion:	Would you buy another Corvette?
Good handling 12.0	Excellent 9.2%	Excellent 20.0%	Yes 87.6%
	Good 25.9	Good 26.1	No 12.4
	Average 17.2	Average 21.8	
	Fair 20.1		
	Poor 27.6		

*Percentages might not equal 100% due to rounding or insufficient data.

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One year with two alternative energy systems

Last year PM installed a solar domestic-water-heating system (page 132, Sept. '79) and a multifuel boiler (page 122, Oct. '79). First-year results are now in.

SOLAR DOMESTIC HOT WATER REPORT



PM's home and shop editor on the roof last year, installing solar-collector plates.

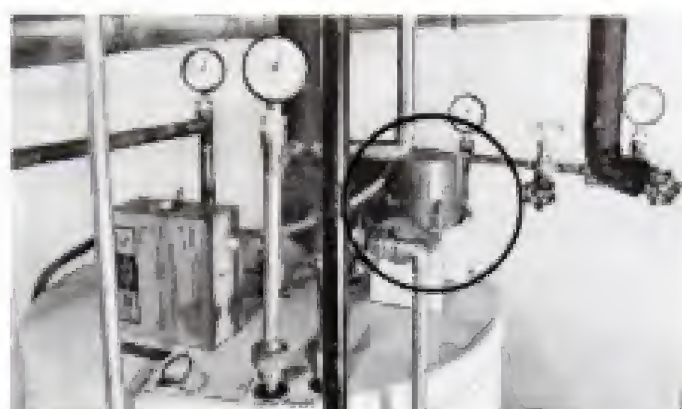
There is no doubt that the solar domestic-hot-water system I installed one year ago is helping to keep down my fuel costs. But there have been problems that PM readers would want to know about.

First, the system has been losing

pressure from the start. We have not been able to locate the cause so, at this time, it continues to drop. Since I do not have the equipment to keep the system charged, I must periodically call in a plumber—with his tools and big labor bill—to pump up the system.

There was equipment failure, too. The circulating pump—which keeps the glycol moving between heat exchanger and collector plates—burned out. The manufacturer was not able to explain why. A. O. Smith did make good on the warranty, replacing the motor without charge. Installing the motor, however, cost me slightly over \$75.

These "piddling" costs obviously lengthen the payback period for the system.—*Harry Wicks*



Problems did arise with pump (circle), and the manufacturer replaced it at no cost.

MULTIFUEL BOILER REPORT

During the winter of 1979-80, I burned about 1½ cords of wood in my new multifuel boiler and used about 335 fewer gallons of fuel oil than the previous winter. No other significant changes were made in the house, and degree-days were about the same as for the preceding heating season.

Since I got the wood free (except for a few dollars spent on gas to saw and haul the logs), I am just about \$300 richer this year. The potential savings are even greater. Because of a problem with my flue that has nothing to do with the new installation, I was unable to burn wood for three of the coldest weeks of the winter. During that period, I burned about 200 gallons of oil.

In theory, the only oil that has to be burned is during mild weather. The manufacturer recommends burning oil (or gas) when the outdoor temperature is above 35° F. In practice, however, it is inconvenient to burn wood all the time. Based on

my experience, if you're considering putting in a multifuel unit, it would be safe to assume a 60-percent reduction of your normal fuel consumption.—*Joseph R. Provey*



During winter, the boiler firebox walls required a weekly five-minute scraping.



During off-season, mixing valve was closed (above, left) and boiler water temperature was kept at 140° F. to allow domestic-hot-water production (above, right).



Stovepipe and flue had to be brushed clean at the end of the heating season.



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Even a brand-new furnace can waste about 45% of its heat in the ducts and chimney. And 45¢ of your fuel dollar along with it.

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Mark Twain: "Thunder is good, thunder is impressive; but it is lightning that does the work."

When Mark Twain held forth at Klapproth's cafe, cigar in one hand, a glass of Old Crow in the other, one expected this kind of wit-filled conversation. Old Crow was so much a favorite of Twain's, he kept twenty-five barrels at the cafe.

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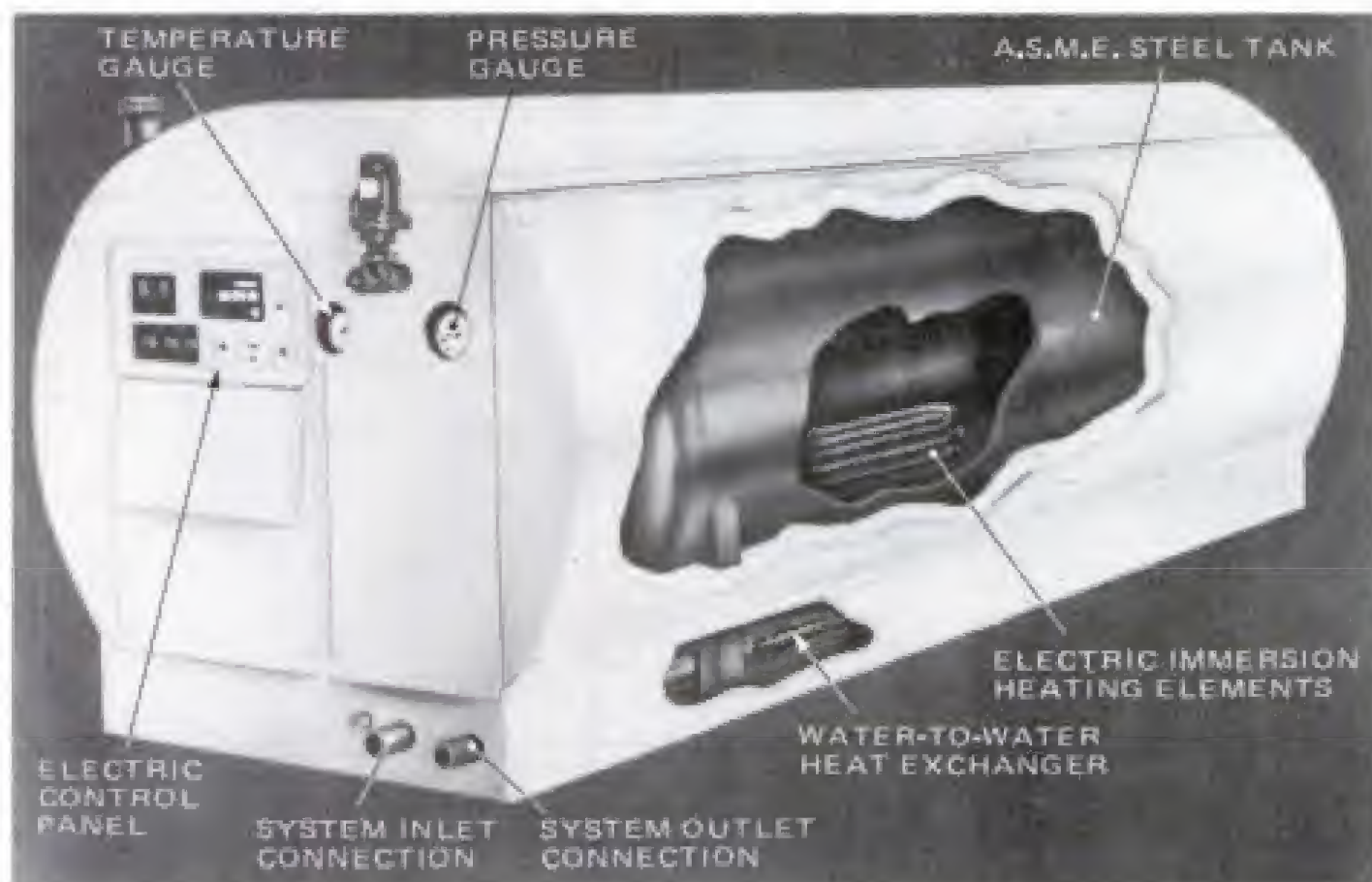
Store heat when electric rates are lowest

If you're thinking about replacing your gas- or oil-fired boiler, and you live in an area where off-peak utility rates are (or will soon be) in effect, consider installing an Energy Bank. It's an electric thermal stor-

age system that is designed to utilize electric energy when the rates are lowest. At other times, heat stored in the 245-gal. tank of water satisfies all of your home's heating demands.

The manufacturer claims that the unit is more economical than an oil-fueled boiler, where oil prices are \$1 per gallon and off-peak rates are in effect. In areas where off-peak energy rates are not in effect, the Energy Bank will save money if the rate is under 4.5 cents per kilowatt-hour.

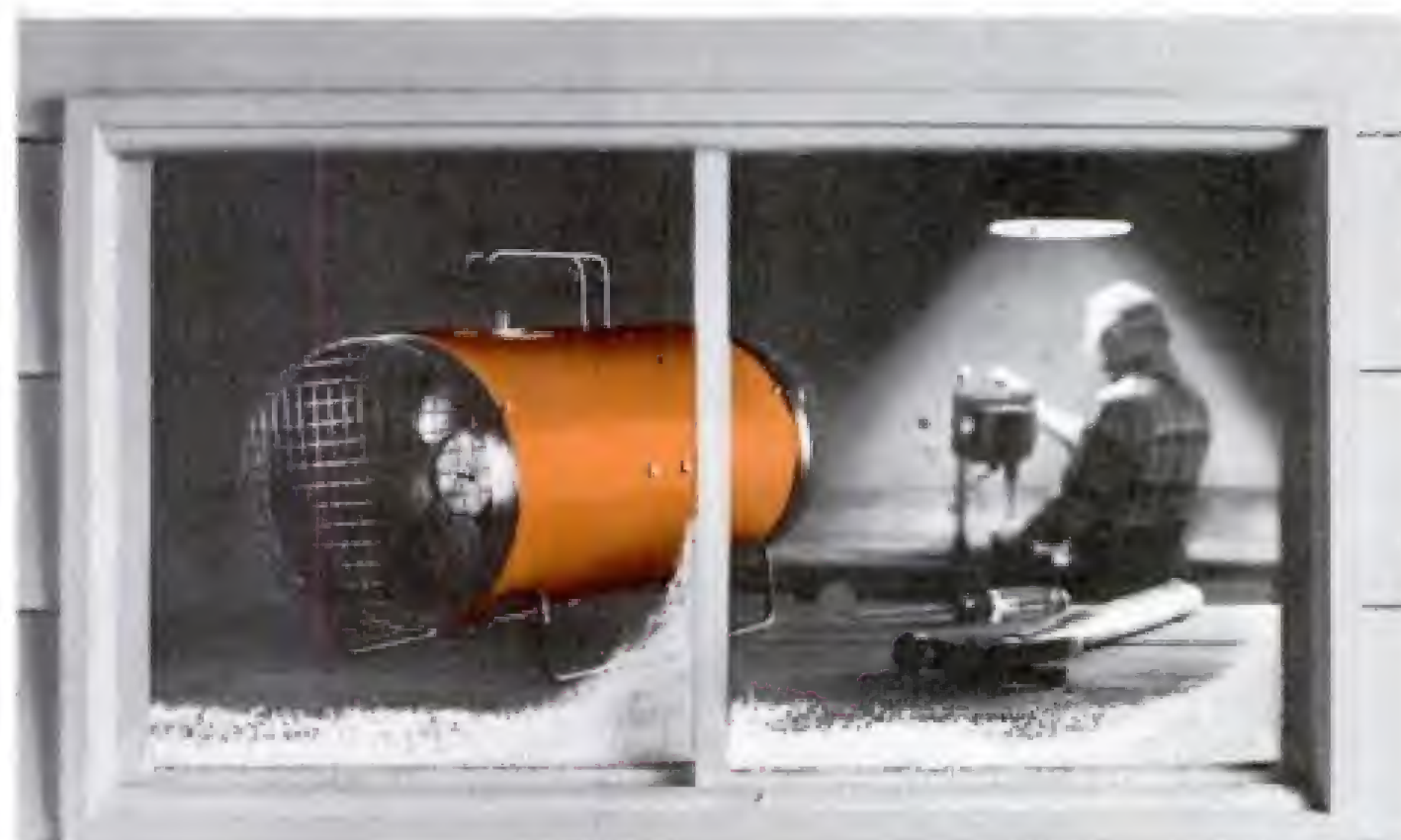
The working principle is simple. Water, permanently stored in the insulated tank, is heated by electric immersion heating elements. A water-to-water heat exchanger transfers the heat to the home's heat distribution loop. In a warm-air heating system, an additional water-to-air heat exchanger is required. The thermal storage unit can also be used to provide domestic hot water.—J.P.



This electric thermal storage system can be programmed to store heat when rates are off peak. The stored heat is then used to heat your home during the high-rate periods.

SPECIFICATIONS—ENERGY BANK

Model: RH 30
Water storage capacity: 245 gal. (A.S.M.E. code vessel)
Height: 40"
Width: 38"; with insulating panels removed: 32"
Length: 104"
Weight: 1100 lbs. (empty)
Electrical: 28.8 kw., rated at 240 v., single-phase input
Clearance requirements: 48" in front; 2" at sides, back, top
Price: \$2890; UL listed
Manufacturer: Megatherm, A Brunswick Co., 803 Taunton Ave., East Providence, R.I., 02914



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Space age accuracy

Now you'll never worry about accuracy again. Because the Sunwatch will keep you on time for the rest of your life. (Accurate to within 1 sec. per month.)

Solar age efficiency

Miniature solar cells automatically convert sunlight, daylight or ordinary bulb light into usable energy for storage. The solar cells last virtually forever. So you'll never replace a watch battery again.

Programmed for over a century

The built-in computer on a chip will always display the correct time date and month. Also, it automatically adjusts the watch calendar for long and short months, leap years and it's programmed until the year 2100!

Easy to read

The natural side-view display lets you tell the time, day and date without twisting your arm into an uncomfortable position.

Numbers always visible

Four varying light intensities are built into the viewing display, allowing the Sunwatch to adjust automatically to any light. This means you can always read it, even in the brightest sunlight.

10 Display functions

The Sunwatch is capable of displaying the following information: hours • minutes • seconds • months • date • day • leap year • speed calibration • AM/PM indicator • seconds count-off.

Extreme accuracy

Unlike other electronic watches using tuned crystals to control timing accuracy, the Sunwatch incorporates a unique, programmable, microcircuit synthesizer to make it the first watch in history that is accurate to less than 1 second per month. That's 5 times more accurate than the latest quartz Accutron.

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Tiny silicon power cells, which are constantly being energized by natural sunlight, daylight or an ordinary light bulb keep the Sunwatch energy storage system charged. Should the watch not be exposed to light, it will continue to operate for months on stored power.

The most indestructible watch in the world
The workings of the watch: solar panels, energy cells, quartz crystal, computer on a chip, etc., are all permanently sealed in a Lexan module. This module is so unique it's protected by U.S. and foreign patents.

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Leave the Sunwatch in salt water for months. Dive with it in depths up to 750 feet. There are no openings — magnetic slide bars activate all functions. With Sunwatch's exclusive, permanently sealed Lexan module, there are no "O" rings or seals to leak.



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You can crash it into a rug-surfaced brick wall at 90 mph with no noticeable effect. Wear it while doing heavy work, exercise or any strenuous activity.

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Put the Sunwatch in boiling water for 30 minutes, freeze it in a block of ice for a year. Extreme temperatures will not damage your Sunwatch.

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Imagine split-second accuracy for the rest of your life. Sunwatch is a virtually indestructible, beautifully styled, space-age timepiece, and it's available in three exciting finishes: Brushed stainless steel, Gold tone stainless steel, or a Durable black finish on stainless steel. All Sunwatches come with a matching stainless steel band with removable links and adjustable clasp.

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The Sunwatch, designed by Roger Riehl, was being worn by its inventor nearly a year before the first electronic digital watch was even available to the general public. Since that time constant engineering evaluations and design improvements have been made on the Sunwatch to incorporate the latest in digital microcircuit and solar power technology. Thus the Sunwatch today represents state-of-the-art electronics technology. It is built to the same rigid standards practiced by the manufacturer in creating sophisticated computer microcircuits for the U.S. Government and other major users of these components.

* A word about other "Solar Watches"

Roger Riehl, designer of the Sunwatch, states that there is no other completely solar powered watch on the market today. Claims of solar power by other watch manufacturers are based on the use of a small solar cell. Due to their limited size, these cells can be proven, in technical terms, to be of virtually no significant value in extending the life of a watch battery. For this reason, all other so-called "solar watches" must have replaceable batteries. The Sunwatch's power storage system, however, need never be changed and is, in fact, permanently sealed to withstand abuse and the elements.

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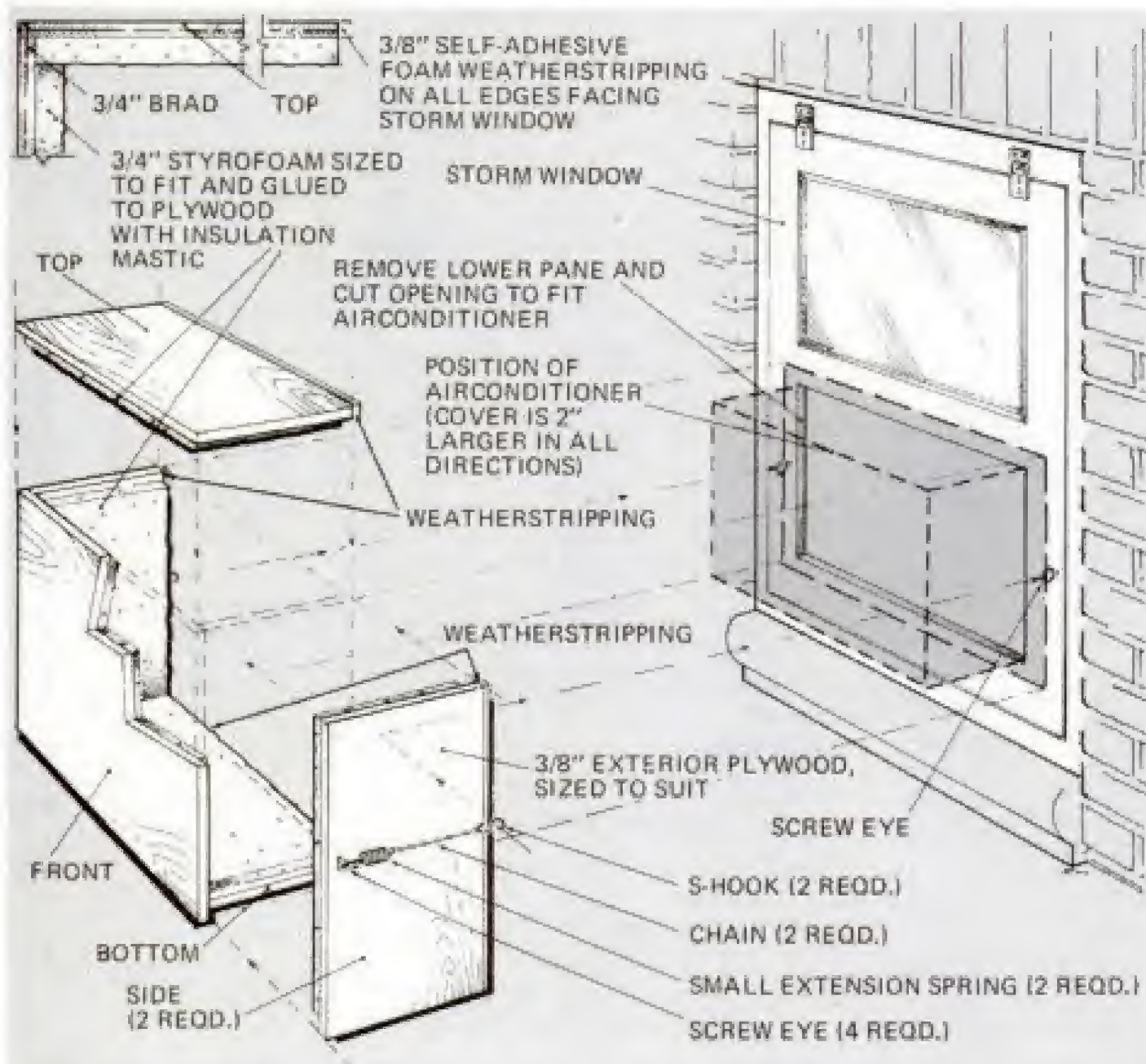
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NOVEMBER 1980 195

5 energy-saving tricks that work for our readers



Airconditioner cover

This cover stops cold winter air from entering the house through the air-conditioner by providing a tight seal around the window frame. If desired, you can use a storm window with it. To achieve a tight seal, position cover and adjust chains until there is even tension on both sides. —Susan Lorenz, Greenfield, Wis.

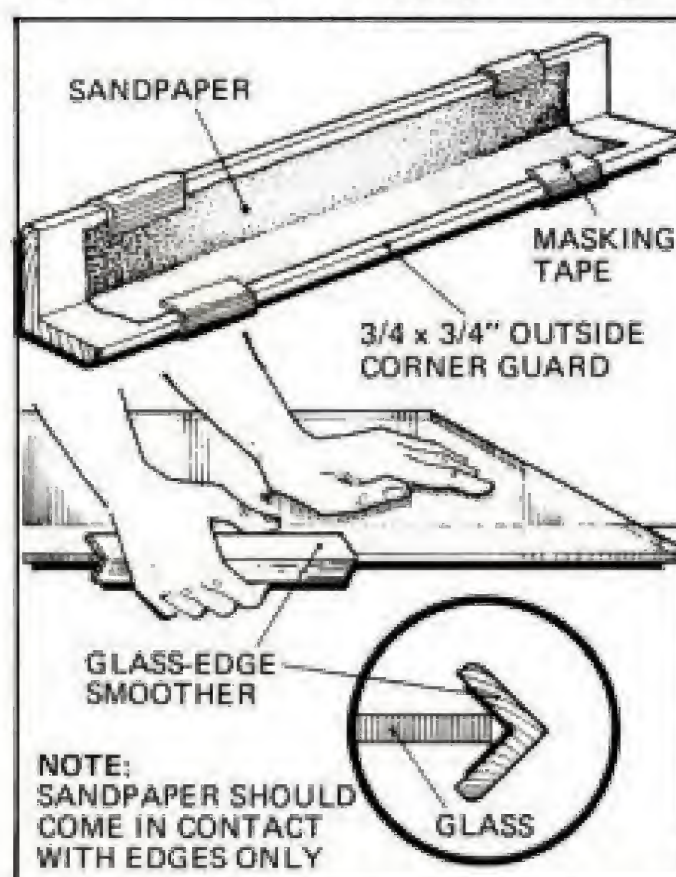
Cheaper dishwashing

You can use this energy-saving idea every time you wash dishes. Unlatch the door on your electric dishwasher before it goes into the drying cycle so the dishes can air-dry. This saves the cost of electricity to operate the drying cycle; it also protects the rubber gasket around the door from drying out due to the heat. —Genevieve Ohlin, Dunwoody, Ga.

Smoother for glass edges

Lower your energy bills by repairing cracked windows before cold weather comes. When handling replacement glass, you can avoid being cut by jagged glass edges by making an edge smoother. I created this simple smoother using an 8-in.

length of wooden, outside corner guard. (Or, fasten two pieces to form an angle.) Fold a narrow strip of emery cloth or fine sandpaper along its



length, position it in the inside angle of the corner guard and attach it with masking or double-faced tape. Then slip on work gloves, position

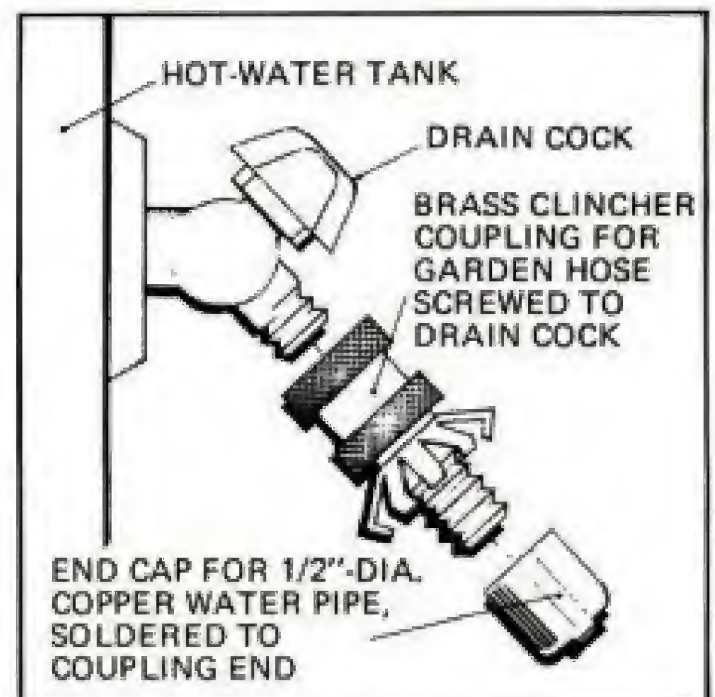
glass edge in angle and run tool back and forth.—A. Weber, Victoria, B.C.

Refrigerator becomes icebox

I've cut down on the consumption of electricity during the winter months by filling four one-gal. plastic milk jugs three-quarters full of water and setting them outside until the water freezes. Then I place them in the refrigerator, at the same time rotating another set of four jugs from the refrigerator to the outdoors. The refrigerator rarely cycles on. The independent freezer control still operates as needed. Vary number of jugs to suit space in refrigerator.—Joseph H. Williamson, Cottage Grove, Minn.

Stopping wasteful drips

Draining a hot-water tank is an energy-saving measure, according to experts. However, I've found that the drain never seems to shut off completely after it's been opened. The resulting drip is annoying and a waste of energy. Yet changing the washer in the drain cock is usually a difficult job, especially in older



tanks. I've stopped the drip by capping the drain cock with a brass clincher coupling for a garden hose, to which I've soldered an end cap used on rigid 1/2-in. copper water pipe. I simply screw this device onto the drain threads.—Arthur C. Erdman, Columbus, Ohio

Share your home energy-saving ideas. PM will pay \$25 for each idea published. Include sketch or photo, if necessary, and a stamped, self-addressed envelope if you want unused material returned. Send to Energy-Saving, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

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348 Build It and Save Money

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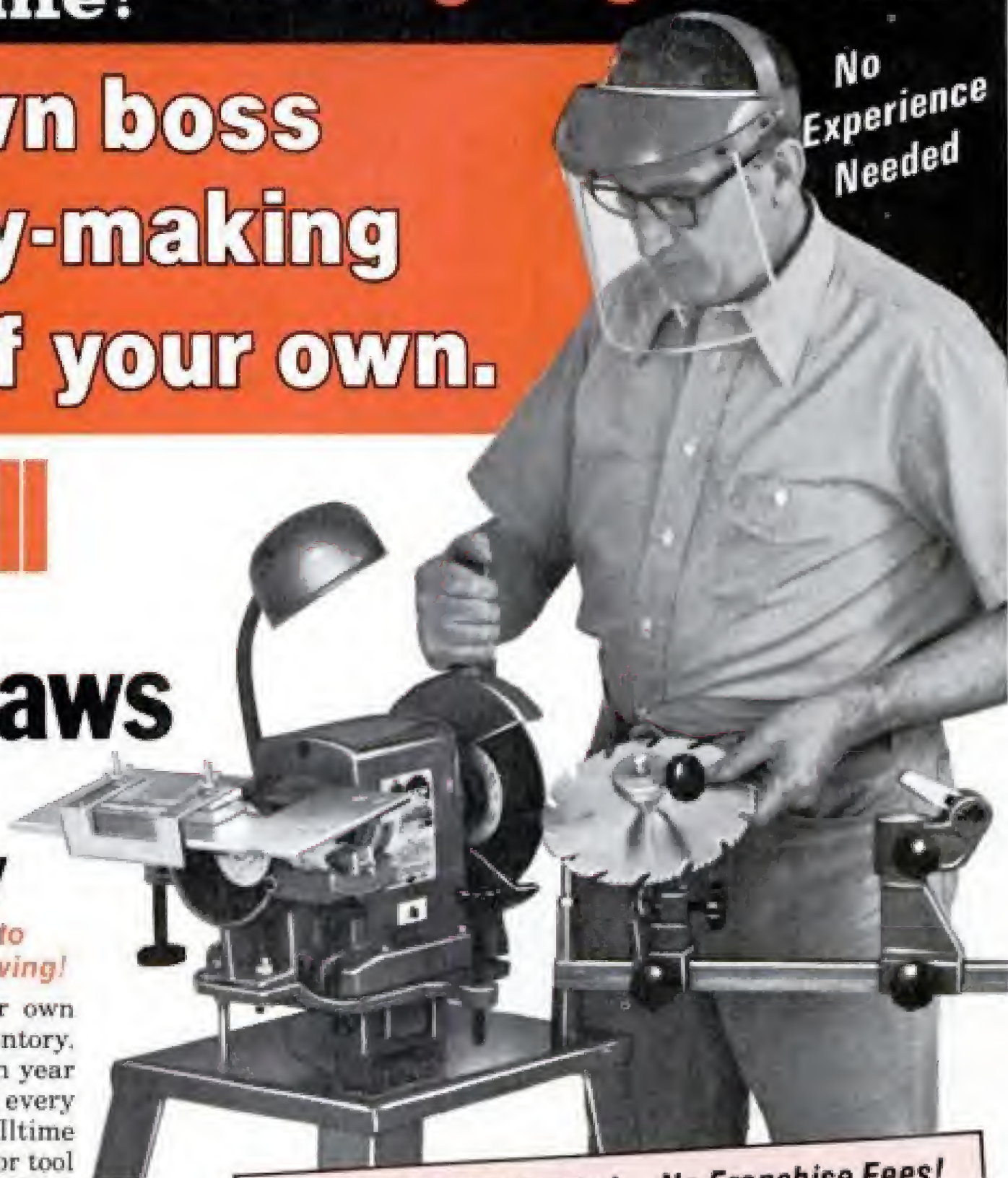
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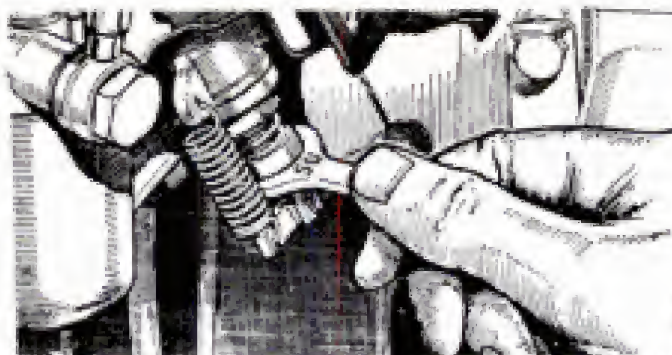
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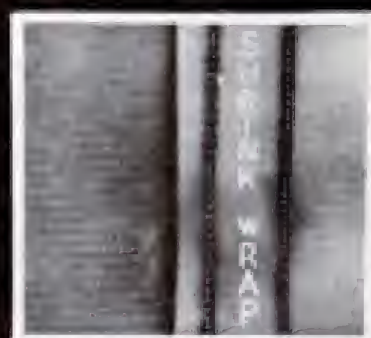
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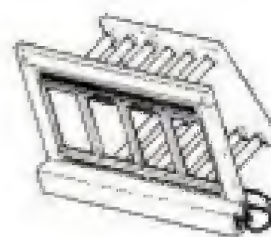
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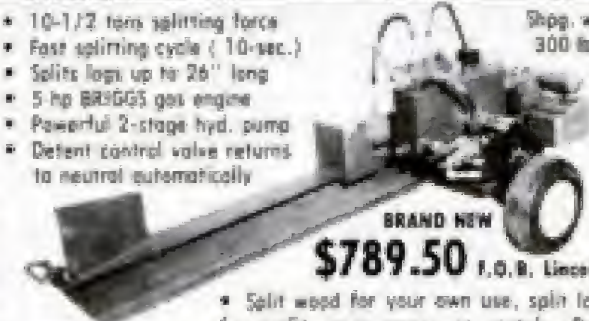


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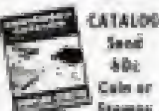
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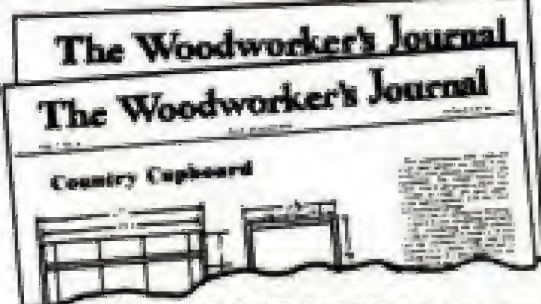
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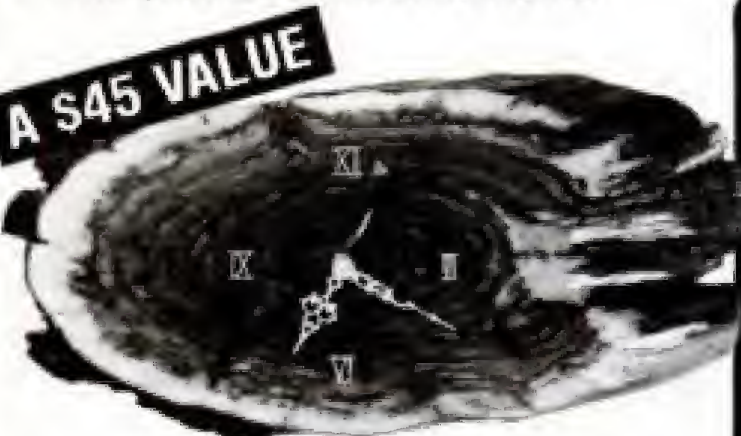
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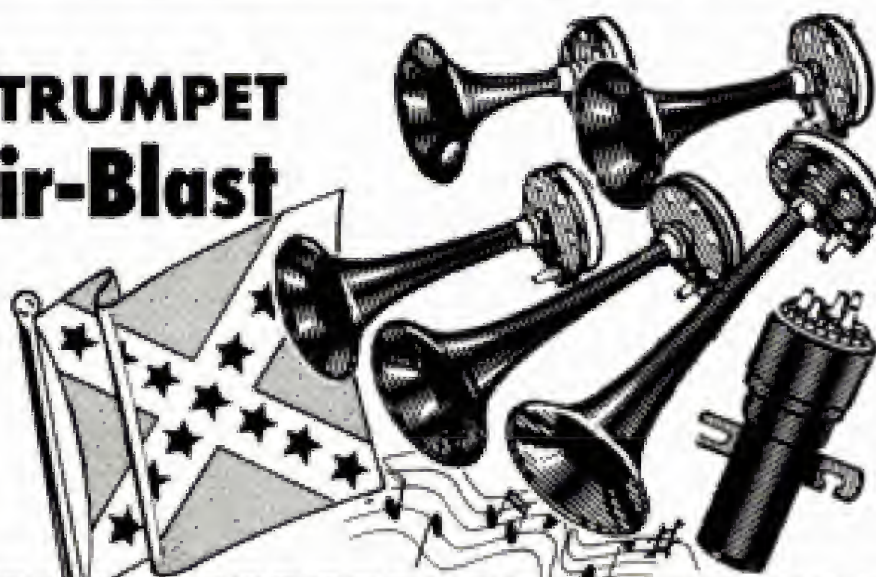
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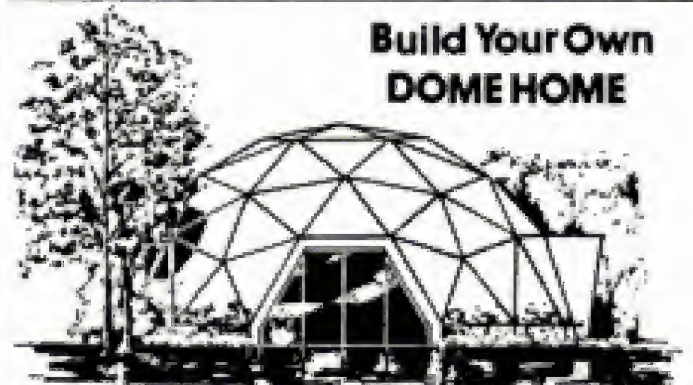
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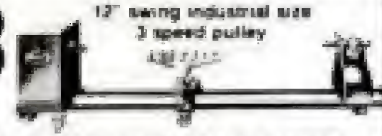


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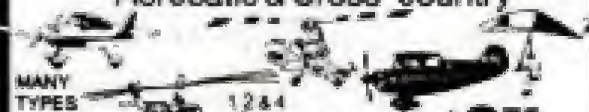


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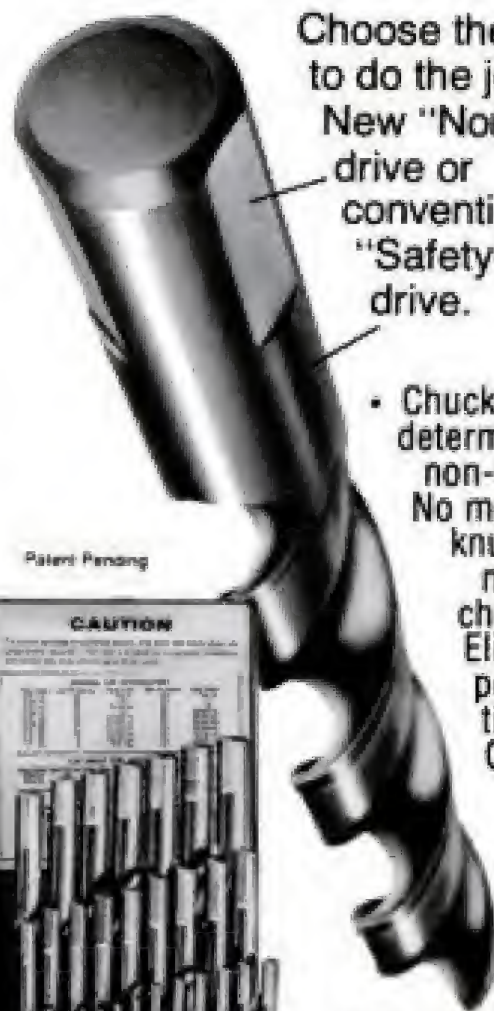
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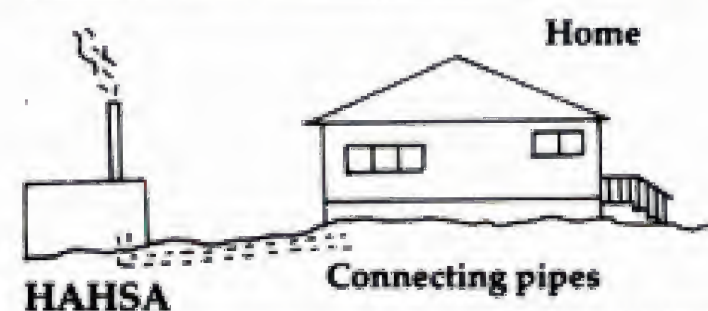
The HAHSA Basics

The HAHSA (Heating And Heat Storage Apparatus) is located outside your house, as a self-contained heating system, connected to your house by 4 pipes which are insulated and buried a foot or two underground.

The HAHSA is basically a burner or furnace completely surrounded by more than 18 tons of sand. This mass of heat-absorbing and heat-storing sand is then surrounded by insulation and a weatherproof structure, say cinderblock. Plus an insulated, weatherproof roof and a chimney.

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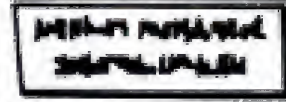
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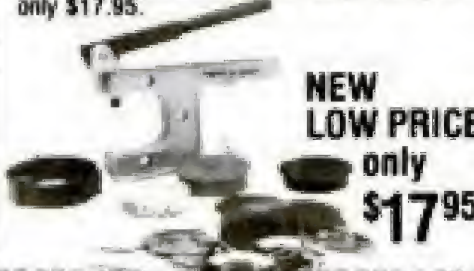
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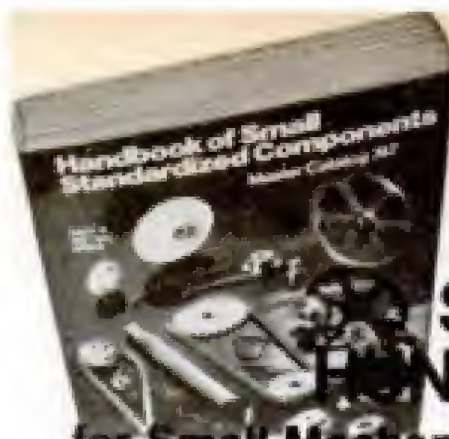


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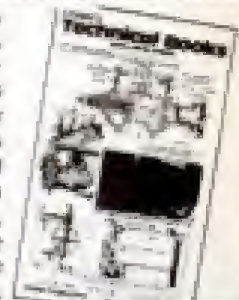
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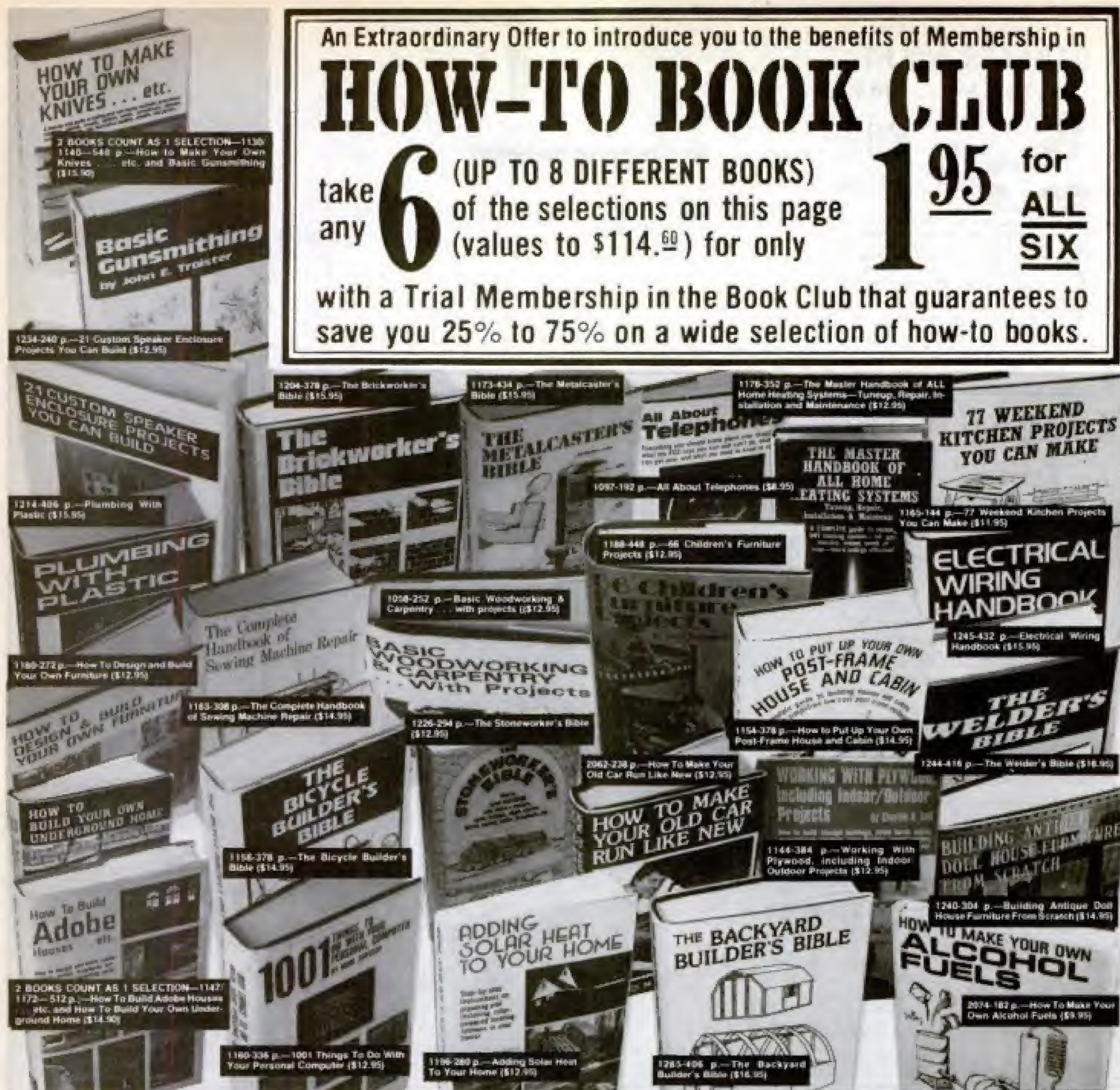
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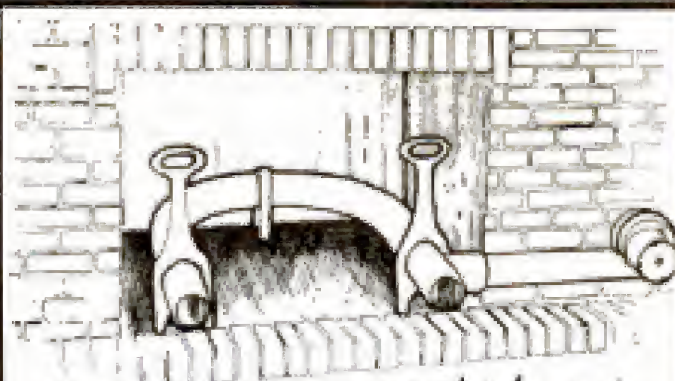
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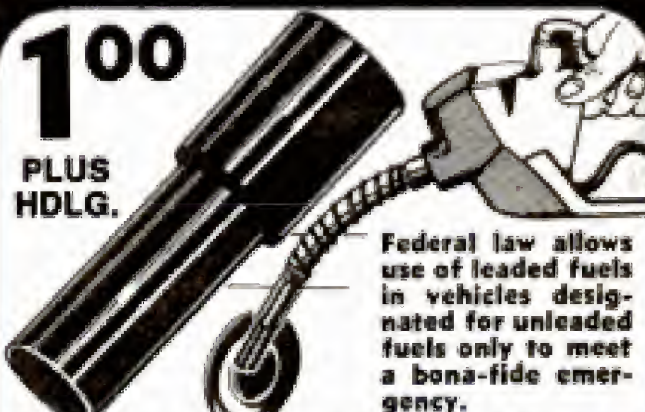
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Kent 100's	14	1.0
Merit	8	0.6
Merit 100's	10	0.7
Vantage	11	0.8
Vantage 100's	12	0.9
Winston Lights	14	1.1
Winston Lights 100's	13	1.0



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Menthol: Less than 1 mg. "tar", 0.1 mg. nicotine;
100's Soft Pack: Less than 6 mg. "tar", 0.5 mg. nicotine;
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